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THE

JOURNAL OF SCIENCE.

NOVEMBER, 1885.

I. THE INTERBOND OF THE SEEN AND THE UNSEEN.

Collated by the AUTHOR OF "SCIENTIFIC MATERIALISM."

(Continued from page 579.)

"There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy."—*Hamlet.*

"I WILL now illustrate the connection between the internal through the organisation with the external,—*i.e.*, what the mind is dependent upon to generate ideas." Forms reflect upon the mind, which reflection is the *idea*. Sounds convey a peculiar vibration, which undulates that portion of the mind with which they come in contact. "This vibration is the idea." Words are the agents of ideas. "The idea once created is irrevocable, and association of the mind with the form external excites and developes the idea first established." Hence learning is a frequent repetition of the association of ideas, "and thus confirms the knowledge through the faculty, or medium termed association, or imitation." All ideas are dependent on exciting causes; yet every thought is an unrestrained production of a mind acted upon by forms, reflections, sounds, associations, or imitation, "and may be termed irresistible impressions." The cause is invisible; it is not the forms, &c., which produce, but the impression which they produce upon the mind. "There is, *first*, the cause;

secondly, the effect produced; and *thirdly*, the thought or idea, or ultimate. *Thought* is dependent; mind is *independent*, not existing with the body as a component part of its constitution, but is an ultimate of organisation; and *thought* is an ultimate of both."

An idea or thought could not be produced without a mind previously existing. The mind would not be *individualised* without the previous existence of the physical organisation; the organisation could not be constituted without its previous and eternal elementary existence; and all this could not exist without a self-existent, unchangeable, and eternal principle. Thus "the visible and external are *effects* and *ultimates* of *invisible*, yet real, producing causes."

When under impression as to his mind Mr. Davis says:—"When the mind becomes free from the organisation it passes into a new sphere of existence. Impressions of Truth, of Virtue, of principles which govern and control and actuate tangible and physical substances, all converge to one focus: this I call the Fountain, the Sun, the Great Illuminator, the unchangeable eternal POSITIVE MIND. This is the great *Positive* Power; all subordinate existence is *negative*. Both positive and negative exist as a united unchangeable principle of all action. Then as an illustration let the mind conceive a wheel, sphere, or circle, and let it be concentrated at the centre of this, and it will be perceived that there is an expansion of circles from the centre to the circumference, or that one wheel cannot exist without another, and so with the Great Positive and Negative, which compose one whole Sphere of Existence. If these two forces produce all existence, do they not from the centre expand to the circumference, passing through mute and modified forms, until they pervade the Universe and constitute the power of all things?" From this Focus I receive impressions, and "become associated with the spheres of the persons or forms with which it is the previous desire to associate. I do not pass the focus of *all* existence, but to the focus of *this* existence." "When I pass from the body . . . it is the transition or metamorphosis of the principle of mind to its second sphere of existence."

"The focus of this existence is but an indefinite expansion of the Great Focus passing from general positive to general negative existence." "To this centre, to this focus," "I go to receive information. As the mind generates thought by coming in contact with external exciting causes in the natural body, so this Mind (the general mind of the second sphere) creates in my mind parallel ideas I term

impressions." Through "the existing medium between the mind and the body I arrive back to convey impressions through the natural organisation."

The ultimate perfection of all substances, the ethereal existence of the spiritual spheres, and the means of impression are evident to me, but so different from the conceptions of the natural mind that it is impossible for me to make them evident to the senses of others. As to my impressions:—

"The human organisation appears as a perfection and combination of all substances below its exalted composition. It is controlled by mechanical and chemical forces, and is a coating, a casement to contain its inward properties. There is another distinct principle which appears, and is evident to me as *Spirit;* also there is a *mediator*, or *medium*, connecting the spirit with the body. The mediator I know as *sensation:* when this medium becomes disunited there is a physical dissolution, and a spiritual elevation to a different sphere of existence. When the mind becomes connected with *this* sphere by a medium similar to that which connects it with the body, it then becomes identified with a personal sphere peculiar to itself."

Man possesses his organs as instruments for external communications, and when transferred (*i.e.*, dies) he retains all the senses in a spiritual condition, and thus becomes susceptible of all properties and elements that compose the existence of all things. The natural organisation perceives appearances as artificial; the spiritual organisation perceives the real and invisible through a sensation peculiarly belonging to its nature.

When in the clairvoyant state the impressions are a knowledge of the *reality* (or essence) of that I desire to investigate without counsellor or informer. All natural things appear closed from view as by a great shade or mantle; all appears one broad and extensive light passing through all the second sphere of existence: the light is the medium of perception and association, and unites them; the reality, the invisible, the real cause of all effects are then known, and this knowledge makes us free.

The laws which govern Nature are established by one Great Positive Power and Mind, and equalled by a negative or ultimate equilibrium. Every particle of matter possesses the same power which governs the whole Universe, and in each particle is seen a representation and evidence of these Divine laws. "Thus in the stone you may see the properties of the soil; in the soil, the properties of the plant; in

the plant, the properties of an animal; in an animal you see man; and in man you cannot *see*, but you can *feel* the immortal principle." The unshackled spirit should be considered as the essential principle belonging to the organisation which can cognize instantaneously all things desired, and with its spiritual senses communicate with spiritual substances. I do not receive impressions from the Great Supreme Mind, but from this second sphere, which legitimately belongs to *this Globe alone*. My information is the result of a *Law* of truth emanating from the Great Positive Mind pervading all spheres of existence.

No "one can voluntarily enter that state in which he can view with clearness things belonging to a sphere of existence higher than the natural world." If such were, death would be inevitable. A medium of connection is required, or the mind could not return, and therefore "it is impossible to go *voluntarily* into the *independent* state of clairvoyance without destroying it." "Mathematically speaking, *two feet* from where I now sit is as much in the future state as any other distance. This consists simply in the *condition* which the mind assumes, and not necessarily in any change of its *location*.

In analysing a substance I separate its constituents until I find its simple elements. By a process of spiritual analysis I obtain truth, and pass from the body with a desire for particular information. This attracts the particular kind of truth of which I would be informed, separates it from all other things, and causes it to flow into the mind. To me all that is known as matter becomes rare and unparticled,—as the ultimate of matter to which is applied the word *spirit*. "Things appear real, to me, which are beyond the reach of the natural organisation, which knows of nothing except what exists in matter and form." All ultimates to me are still *matter*, to you they are spirit. "To make the understanding analogically convinced of the ultimation of matter termed spirit, it is necessary to commence at the beginning of all things formal and rudimental, and trace them evidentially and naturally to their ultimate perfection." "*Natural* things cannot produce *supernatural*: this term is only applied to *effects* where *causes* are not evident."

"It is a law of *matter* to produce its ultimate mind. It is a law of *mind* to produce its corresponding principle *spirit*." The nature of spirit is to progress to knowledge. All forms are correspondents of their inner life, which, working by an undeviating law, produces rudimental sensation in the

organic system, and becomes a part of animal existence. "So, tracing the refinement of matter from vegetable existence (the life or soul of plants being perfected to become animal sensation), the refinement and perfection of these two to become the substance of mind,—and the progression of its nature to its second sphere and investiture,"—you arrive "at a positively individualised condition, and existence of mind in its first ultimate state of progression."

"There is no such thing existing as positive inertia in matter. If such did exist, man then possesses the power to create; but if there be no such thing, then man has merely the power of developing."

Stones develop like other forms in Nature, as shown by the appearance on their surfaces of decomposition and decay. Where decomposition takes place, re-composition must also have place; for matter is indestructible,—therefore rocks give particles to and take them from other bodies. "There is a constant and undeviating action which produces and reproduces all forms visible and external. Composition, decomposition, re-composition, visible and invisible," perform their natural and ceaseless work; "hence there is a ceaseless chain of formation and reproduction." Thus in Nature every particle of matter, being governed by its law, produces harmony and union in all parts of existence; with an undeviating tendency each particle occupies its destined spot, there to form what is required of it.

The motive power of all life and activity in Nature must be a part of it, because it cannot act separately from it. Motion is there, co-existent, co-essential, and co-eternal with Nature. What is known as motion is not properly life, for motion exists where life does not. The accumulation of particles from combined elements in the interior of the earth form ore, progressing to metal, which then possesses no visible motion nor activity, but time will develop its slow and perfect action, rust accumulates on its surfaces, and finally the whole becomes dissolved and disunited: this illustrates the steady motion existing as an invisible reality.

Peculiar kinds of earths become minerals: at a long interval of progression earths and minerals associate, and form vegetable existence; so, by progressive refinements, particles of mineral and vegetable kingdoms "are rendered capable of becoming the substance of *animal organisation*."

In grosser matter there is contained the primitive and essential principle of motion, yet no combination of numbers

could express the periods of years intervening between the first rudimental stages of matter and the formation of minerals. Then is drawn a picture of a person contemplating the advent of life on Earth—life as a new development of the law of motion: the progression of life would be gradual until man was reached, his physical organisation being but an ultimate of matter, an effect produced by an invisible yet eternal cause. Man is now one among millions of forms apparently self-existing, and isolated from the great mass of universal progression.

Man possesses more than life and sensation, and for want of capacity (*i.e.*, want of a higher sphere whereby can be associated that which belongs to this) a conclusion is drawn that because Motion, Life, Sensation, and Intelligence are existing in one form, a theory is sanctioned that Intelligence results from organisation; hence, in the investigation of man's composition, erroneously the conclusion is arrived at that the principle of mind is eternal, yet not individualised. No substance has the power, whether it be physical or intellectual, of self-comprehension. Grosser substances can be traced to the formation of Man, and then Mind, Intelligence, *Spirit:* although all below is correctly comprehended, here there is a confusion, too much belief or unbelief,—the natural consequence of a principle attempting to investigate itself.

It is necessary to understand the classification of Series, Degrees, and Representations, in order that Nature and her co-existent laws may be comprehended—a focus formed of nebulous matter; in other words, a centre produced by a conglomeration of particles must of necessity be a body crude and heterogeneous, yet a *cause*,—the inherent principle in *Matter* known as *Motion*, is co-existent with it. "Such an incipient formation is the only basis on which can rest a proper understanding of the potency of matter and the excellency of ultimates." The correspondential reasoning is based on "the Cause, which is perpetually producing ends and effects."

"There is an invisible Cause producing spontaneously external Effects: these may be divided into *series*, *degrees*, and *representations*. At first Motion and Matter existed: these formed one series. Vegetable production and its . . . developments, and accompanying life, are a *second* form and degree. Animal organisation is a *third* development, or an ultimate, or inward or first cause; its kingdom is a *third* form or degree. The whole forming three series:—*First*, Matter spontaneously producing and reproducing ends or

ultimates. *Secondly*, Motion . . . developed into forms suitable as agents and perfect as ultimates to develop its inward principle to the external sphere." "Thus, *first*, matter; *second*, perfect vegetable existence; *third*, matter in animal organisation as its highest state." "There are three *series* or *degrees*. *Thirdly*, Motion as a co-existent principle with Matter, Life as an effect, and Sensation as an ultimate or end; constituting three series or degrees of the progression of matter and its inherent motion."

Then follows an illustration derived from the pathology of the human body (*vide* pp. 66 to 69).

"There is no such thing as absolute *creation*; what is termed such is merely a development of inherent principles which are eternally established and sustained." "Admit that Man is a link (manifest to the senses) in the great chain of correspondences, and then belief will be reposed in the one great power which is governing and controlling all things, and has established a law equal to its own comprehension."

Of the motions which are developed in Nature, and which act on geometrical and mechanical principles, and vary as to the forms and circumstances of their outer manifestations, there is the *rectilinear*, which progresses to the *spiral*; the *curvilinear* was next developed, and other motions legitimately followed, as vibratory, undulatory, eccentric, and spiral or ultimate motions. The first motion contained the specific properties and forces of all the others, produced by and according with the law of universal energy. Thus it is established that matter contains within itself an eternal law of progressive activity,—also a corresponding law of life and action existing individually and essentially with matter; the whole containing forces and materials to produce in future developments all forms and substances in existence. The whole is composed of parts, they being necessary to compose the whole; the whole is a vast machine operating unceasingly by an inherent principle of perpetual action. The whole a *mechanical operation* developing each principle and force, each object and form known to the senses, and governed by the principle known as the *Law of Nature*. So far scientific investigation leads to this conclusion: pause cannot be made here, but further search is made for the *First Cause*. An inductive mind will observe the indications which all Nature presents as pointing to the *Great First Cause, or Positive Mind*. Upon such a basis the mind will rest satisfied: the search to find a cause *still* ulterior is absurd, and even beyond the powers of conception.

On such foundation the mind contemplates Nature producing grand effects in infinite progression, and cannot fail to perceive the adaptation of means to an end as displaying *proof of design*. The cause of all things lies deeply behind all external appearances. Thus a sure basis is given whereon to test the hopes of the future. A future life is proved, making it sure and eternal as the laws which govern the Universe. It is not the object at this time to prove its *how* and *what*, but that it *shall* be. Presently I shall trace generally and particularly, from the Great Positive Mind, the Cause, Effect, and Ultimate of all things; and this will exhibit the infinite progression of all particles in existence, and show that this progression developes the principle so long involved in obscurity, *viz.*, SPIRIT.

The original cause was Nature as a means to produce its ultimate, *Spirit*,—which must be individualised to establish communion and sympathy between the Creator and the thing created, for the Spirit progresses to the source from whence it came, and then only becomes fitted for new spheres of its eternal existence.

By palætiological facts* it is proved that the substance or essential principle becomes *individualised* when Man is made the instrument, and by such individualisation it becomes the future and corresponding principle, Spirit. Matter contains the essence and properties to produce Man as a progressive ultimate, so Motion contains the properties to produce Life and Sensation; these together, perfectly organised, develop the principle, Spirit, not as a consequent of the organisation, but as the result of the combination of all the elements and properties of which the organisation is composed. Such principle (Spirit) must have existed eternally as emanating from the Great Source and Fountain of Intelligence.

Man developes from the germ, until finally the original cause developes, in his maturer condition, the principle of *spiritual life*, whilst he, again as a material substance, reproduces his like, and thus he forms one circle of united action.

The geologist, investigating strata, finds the remains of "Mollusca, Radiata, Articulata, Vertebrata (forms and

* Palætiological is explained by Mr. Fishbough to come from *palaios*, old or former, *aitia*, a cause, and *logos*, a discourse. Palætiological sciences are those sciences *formerly* established which conspire in the formation of a cause or foundation from which other conclusions may be developed. The word claims Geology, Anatomy, Physiology, &c., forming proofs of the united chain of existences.

animals existing, which were successively and gradually developed, accompanying the formations of rock in which they . . . are found), each form a successive link of the forms produced." "At each geological epoch there are seen corresponding productions of the Vegetable and Animal Kingdoms."

"The *atmosphere* which surrounds this Globe has corresponding strata of formations, each holding a position in rotation to the Earth according to its specific gravity. The Earth possesses an attractive power over the same, the influence of which counteracts its expansive force, and prevents the formation of an atmospheric connection with other earths in existence; each stratum exerts a pressure on that which is beneath it, and the whole produces a weight which is confining every particle or substance existing upon the surface of the Earth."

Nature must of necessity, according to an Eternal law, operate as an effect or secondary cause to produce higher and more perfect spheres of material existence. "It was the object for the Earth gradually to progress in its material perfection, to produce plants, animals, man. It is also the object for Motion, Life, and Sensation to combine with the perfection of the former to produce the principle of *inner life*. . . . So the First or Great Positive Mind operates as a Cause, through Nature as an Effect, to produce Spirit as an Ultimate."

"Is there not an internal and external evidence of this which transcends words to express thought? Are there not inward convictions dwelling in the mind corresponding to its desires for a future and eternal state? Does not the *internal* constitute the *substance* of the external? Does not Nature as an *external* effect point deeply and indirectly to the *internal* or fountain of its original production? Do not the inseparable truths which each science unfolds . . . terminate in one common focus?"

All this evidence is contained in the physical organisation of man, yet, owing to his sphere of existence, the subject of a future life cannot be demonstrated to his senses. Man contemplates Nature and her laws as eternally and invisibly producing results according to their inherent qualities and forces. The highest and most important subject to comprehend is the inward reality which constitutes the ultimate existence of the contemplator.

The *Uniformitarian* system of Geology, by internal and external evidence, demonstrates its truthfulness. In various parts of the Earth strata have been deposited which are

absent in other parts. Nature in a *particular* sense has manifestations of catastrophic events, yet in a *general* sense there is a manifestation of steady and universal formation. The anatomy of the Animal Kingdom teaches an important truth—"*original and eternal design.*" From the considerations of Cosmic relations and phenomenal display a conviction is produced in the mind that there is an inherent and necessarily intelligent Principle existing, because a contemplation of the whole discloses a united chain of harmonious development displaying order and progression,—all of which must be conceded as the production of the *Great* Positive Mind.

Mechanical principles constitute the united actions and forces of Nature; and here only can the mechanic receive instruction, for do what he will he can only develop the principles contained in them.

"Reasoning from the established axiom that there must be a *Beginning* or a First Cause to produce corresponding ones, it follows that either *Matter* has existed from all eternity or else the essence of an *Intelligent* First Cause. One or other of these conclusions must of necessity be drawn from the indications which all external substances and forms present. The idea is indisputable that *something* must have *originally* existed to produce that which does now *exist.* That matter and motion must have existed independently, or that the Great Cause must have been the *Productor* of that which does exist. The mind is therefore led back from effect to cause, until it conceives of the *First* Cause, or rather is compelled to admit the existence of such."

The sum of the arguments, for many pages, shifted and changed in all manner of ways, and an almost endless repetition of that which has gone before (yet all conveys to the reader a feeling of astonishment that such enunciations should have proceeded from an unlettered boy), is that the whole Cosmos was designed to individualise Intelligence, from which Individualisation is manifested Spirit; that the creation of the whole Universe was for this end, and that each change, inorganic and organic, was but a progressive step; that all the facts of Nature show design; that the Great Positive Mind is eternal; that Matter, the product used for its purposes, is also eternal—because of its origin; so Man, its ultimate as Intelligence or Spirit, is also eternal.

He claims to have proved an *Intelligent First Cause,* "and

the positive individualisation of the inner life or *spiritual principle.*

N.B.—The Key (this part of the work) was delivered from the *second sphere.* In the delivery of the following work he ascends gradually to the seventh sphere : the *How*, *What*, and *Shall* is then to be explained.

(To be continued.)

II. A THEORY OF THE ACTION OF CHEMICAL FORCES.

ATOMICITY is considered by Mendelejeff to increase from the beginning to the end of the septenary series; but it is seen that this is apparent rather than real if we examine the illustrations advanced in support of this view.

First cycle (oxides)—

(Li_2O) G_2O_2 B_2O_3 C_2O_4 N_2O_5

Second cycle (oxides)—

Na_2O Mg_2O_2 Al_2O_3 Si_2O_4 P_2O_5 S_2O_6 Cl_2O_7

In the above table the succeeding elements in each of the two simple cycles combine successively with one, two, three, four atoms of oxygen, and upwards; and since the atomicity of oxygen is two, an element which combines with one atom of oxygen would seem to be a dyad, an atom which combines with two atoms of oxygen to be a tetrad, and so on. But while the first elements in each cycle are strongly positive, and produce oxides of a basic character, the last elements are negative, and their oxides are acid-producing bodies. And only in the middle of each cycle do the elements form oxides which are approximately indifferent or neutral in character. Oxygen is itself negative, and when combined with positive elements its effect is to neutralise to some extent their positive properties. Thus the oxides of the alkali and alkaline earth metals are powerful bases, while

their peroxides are unsalifiable. When the element is of feeble polarity the oxygen determines a slight preponderance of negative properties in the compound, as in the case of silicic oxide. When combined with negative elements the negative character of the oxygen is superadded to the negativity of the negative elements. At the same time the stability of the union decreases as the negativity of the element becomes more pronounced. The oxides of sulphur are formed by direct synthesis, and are comparatively stable; the oxides of chlorine are not formed by direct union of the elements, and are decomposed under conditions of slight disturbance. This indicates that the atoms of oxgen in the oxides of chlorine are linked to each other,—evidently a condition of unstable union. The salts formed from these anhydrides are more stable, because the positive element reinforces the feeble polarity of the chain. If we examine the chlorides of the elements we find less evidence of high atomicity in negative atoms; and if we consider those cases where union takes place between mutually attracting elements of opposite character, and produces neutral, stable, substances as the result, we find, on the contrary, that not only do the most negative elements possess low atomicity, but that the progression towards this condition is regular in each cycle. Thus the metal sodium combines with one atom of chlorine, and the metal magnesium with two atoms. The earth metal aluminium combines with three atoms of chlorine, and silicon with four atoms of chlorine or of hydrogen. Phosphorus combines with three atoms of hydrogen, and with three positive atoms by means of intermediate oxygen atoms in the orthophosphates. Sulphur combines with two positive atoms in sodium sulphide, and indirectly with two atoms of sodium in sodium sulphate; and chlorine combines with one positive atom in sodium chloride. And if we confine the conception of atomicity to cases of union of elements resulting in the evolution of heat, in stability of the molecule, and neutrality, caused by satisfied affinity, we find it everywhere to be highest in the middle of the cycle. In the middle of the cycle, also, we find the minimum of atomic volume, and the occurrence of the properties which seem to depend upon proximity of atoms, *viz.*, high melting-point, rigidity, and minimum expansion by heat, and that these properties of matter always occur simultaneously with high atomicity is evidence of the existence of a common cause of the phenomena.

The attraction between atoms, which brings about chemical union and the formation of the molecules of compounds,

in some respects resembles electric and magnetic attraction; it is greater between two atoms when one is more strongly positive and the other more strongly negative. Cohesion, that is, the force which controls the distance separating atoms in the liquid and solid condition, resembles gravitation in not exercising this selective attraction, but differs from it in taking place only through small intervals of space. The same difference also distinguishes chemical action proper from electric and magnetic attraction. Although chemical action proper and cohesion thus differ so widely, it is possible that the same causes which produce the one produce the other. For cohesion is greatest where the atom has the power of uniting with the greatest number of atoms of opposite character, and least where the atom is a monad.

We can imagine that these two attractions are the results of the action of elements of force, which we may call *chemical poles*. The *pole* is the immaterial counterpart of the atom. Each is minute, indivisible; the atom is the unit of matter, the pole the unit of chemical force. A pole is indivisible, and cannot coalesce with any other pole, although there can be mutual inductive action between them. This mutual action resembles the induction which takes place between magnets and between electrified bodies. Poles differ in kind, being negative and positive, and chemical action proper is the result of the attraction between pairs of poles, of opposite character, or at least of unequal intensity, each pole attracting only its fellow in the pair. Cohesion, on the other hand, is the result of the general attractive action of poles, the influence of each being diffused over all other poles within the range of its power. A monad atom is the *locale* of a single pole, which dominates it. A dyad atom is possessed of two poles, each of which acts individually upon outside atoms, and exerts an inductive action upon its fellow in the same atom. The inductive action lessens the power of each pole, and hence chemical affinity is less intense than in the monad atom. In the same manner a triad atom is the seat of three poles, each less intense than either of the poles of the dyad atom in the same cycle. But the sum of the general diffusive attractions of the three poles is greater than the sum of the general diffusive attractions of the two poles in the dyad; therefore the atomic volume of the triad is less than the atomic volume of the dyad. And since the poles are links binding all adjacent atoms to one another, the resistance to the dissolving tendency of heat increases with the number of poles. A

dyad therefore melts at a higher temperature than a monad, and a triad at a higher temperature than a dyad. The same increment of heat causes less expansion where each atom has a number of poles than when the poles are few: the vibratory movements constituting heat and electricity can be more readily communicated from atom to atom when they are near together, but unconstrained by manifold attractions to move within narrow limits.

Chemical force is, in a sense, a polar and dual force. Positive poles attract negative poles, but they do not repel positive poles; on the contrary, they exert an attractive influence of indefinite character upon all positive poles within the range of their power. Chemical poles act inductively, not only upon each other when in the same atom, but upon poles in other atoms. If the intensities of the poles are unequal, but of like kind, the stronger pole induces in the weaker pole an intensity equal to its own, but of opposite kind, and the difference between the induced intensity and the original intensity of the weaker pole is the measure of the affinity between the two poles. Since no two elements have exactly the same affinity it is always possible for them to combine (under proper conditions of temperature, &c.), but the more nearly equal and alike are their affinities the less is the attraction between them.

There is under certain circumstances definite union between atoms of the same element. This arises when the general diffusive attraction of poles, or cohesion, is overcome by heat. In the solid, cohesion of atoms produces rigidity, hardness, elasticity, and the ordinary phenomena of solidity. In the solid, each pole is bound by attraction to a number of other poles, and its motion is confined within a narrow range. As the temperature increases its tendency is to overcome the cohesion of the poles, but one pole has always, by force of position, a greater cohesion for one other pole than for the rest. As the atoms break away from one another the hardness, rigidity, and elasticity of the solid decrease. At a certain stage each atom on an average coheres to two others, to one more strongly than to the other. The solid has then reached the pasty condition immediately preceding liquefaction. As the temperature increases the third atoms begin to break away, being themselves held more powerfully by other atoms; the solid is now melting. Finally, when all the cohering atoms have formed into pairs, each atom of which is free to roll round the other, complete liquidity is attained. The atoms, however, are still sufficiently near together for each pole, as its atom rotates round its fellow,

to come temporarily within the sphere of power of other poles, and thus groups of three atoms are being constantly made and broken. This residual attraction of third poles constitutes viscosity, and also keeps the liquid within the narrowest limits. The further addition of heat causes the residual attraction of third atoms to vanish; the pairs of atoms now fly asunder under the influence of impact: the body is a gas. Each of the pairs is a molecule; and the attraction holding the atoms in the molecule together is not chemical attraction proper, as between unlike and unequal poles, but a concentrated remnant of the general diffusive attraction of cohesion which a pole in the solid exerted upon all others within its range of power. The manner in which a solid breaks up into pairs of atoms can be illustrated in a very simple manner. Take a strip of paper a few inches long and of uniform width, and cut partially across the paper in two places, so as to divide it into three equal segments.

However equal in strength the connecting uncut links between the segments may appear, it is impossible to so pull the segments apart that the middle one shall be left free of both the end ones. One of the two is sure to be a little stronger than the other, and the middle segment remains attached to one or other of the end pieces.

The opposite nature of positive and negative poles is seen in the influence which the mass of the atom seems to have upon its affinity. The positive elements of highest atomic weight have the most intense affinity; cæsium is the most active alkali metal, and lithium the least active. Iernium (at. weight about 225) will be more active than cæsium. On the contrary, negative atoms of least weight have the most intense affinity; chlorine is generally more active than bromine, and bromine than iodine.

The exercise of that form of attraction by poles which we have termed chemical attraction proper evidently does not prohibit the attraction of cohesion which each pole can exercise. The cohesive attraction survives after the affinity of the poles is satisfied, otherwise all compounds would be permanent gases. But the ratio of the two attractions is not constant in all poles. Hitherto our illustrations have principally been taken from the first two or simple cycles, and we have seen how closely atomicity and atomic volume

are associated in them. All higher cycles are complex, each containing two or more of the primary septenary series, the "octaves" of Newlands. The third and fourth cycles have each two primary series, with three intermediate elements, which latter are the iron group and the first platinoid group respectively. The first member of each of these cycles is an alkali metal; the first members of the second septenary series in each are metals, copper in the third cycle, silver in the fourth, which differ vastly from the alkali metals, but which are held to have some analogies with them. These analogies are due to atomicity. Copper forms compounds in which the metal is a monad, and the only (or almost the only) salts of silver are of this class. Silver and copper, however, are widely different from alkali metals in most other respects, notably in being very inactive chemically, and in having high densities. Evidently, then, the atoms forming the higher cycles have conditions absent from the elements of the simple cycles, which impress upon these cycles their complex character. In the third cycle elements for the first time depart from the primitive order. The first element of each primary series is no longer in all cases an alkali metal, but may be a metal of a new and distinct type. In this new kind of elements the poles are of a second order, in which the ratio between chemical attraction proper and the attraction of cohesion is changed. Chemical attraction is less and cohesion is greater,—hence the characteristic inertness of the atom. Chemical activity is a function of the two forms of attraction, directly of the first, inversely of the second. The first proposition needs no demonstration, and the second is true because the attraction of cohesion must be overcome before union with unlike atoms is possible.

Atoms are subject to periodic modification as a law of their being. There is lithium, and six succeeding elements; then again an alkali metal and six succeeding elements, repeating the type of the first. The cycle advances by *transitions*, the progression being nowhere broken, but always moving regularly from type to type. The third cycle begins with an alkali metal, and its second and third elements closely resemble their lower atom analogues. Afterwards the resemblances are less distinct; the cycle is in transition towards elements of the second order. High atomicity, high melting-point, and low atomic volume culminate in the iron group; and the succeeding element, the first member of the fourth septenary series, has poles of the second order. Chemical activity is least at this point, and density, melting-

point, and atomic volume no longer return to the type of the alkali metals. But although there is no recurrence of the former monad type, there is distinct evidence that the fall in atomicity is not without influence. The atomic volume rises, the melting-point falls, and the expansion by heat becomes greater at this point. Copper and its analogues, silver and gold, are in each cycle the elements of least chemical activity, and are by far the best conductors of heat and electricity. Malleability and conductivity are properties possessed by positive elements, and by positive elements of low activity, to a greater extent than by positive elements of high activity. The elements of the intermediate groups preceding copper and its analogues are held together by more poles, and are harder, more brittle, and more rigid; copper and its analogues are held together by poles fewer in number, but of higher cohesive power, and these metals possess more malleability and softness, and are better conductors. The atoms, while strongly cohesive and close together, are more capable of relative motion.

In the elements of the series commencing with copper (silver and gold) the transition proceeds in the opposite direction,—that is, to the occurrence of poles of the first order. Atomicity rises and then falls to the monad halogen type, the change being accompanied in a rise and fall of the melting-point, and by a small but sensible depression in the curve of atomic volumes.

III. "SOLAR LIGHT AND THE EARTH'S ATMOSPHERE."

By the Count O. Reichenbach.

A LECTURE on the above subject was delivered on April 17th, 1885, by Prof. J. P. Langley, at the Royal Institution.

Speaking of his observations during his expedition to Mount Whitney, the lecturer said:—"The results, stated in the broadest way, mean that the Sun is blue; but mean a great deal more than that, this blueness in itself being

perhaps a curious fact only, but in what it implies of practical moment."

"We deduce in connection with it a new value of the solar heat, so far altering the old estimates that we now find it capable of melting a shell of ice 60 yards thick, annually, over the whole Earth," &c., "and we have found that the total loss by absorption from the atmosphere is nearly double what has been heretofore supposed."

Pouillet found that solar heat might annually melt 30·87 metres of ice, but that this was not all the heat received from without; he attributed the surplus to space, and made it equivalent to melting 26 m. of ice. He therefore estimated all heat we annually receive from without equal to melting 56·87 m.

Pouillet took 75° C. for the specific heat of ice melting; Prof. Langley, 79·25°. By applying 75° his 54·87 m. increase to 57·7 m. The two observers differ, therefore, not as to the quantity, only as to the sources of heat.

In September, 1882, a volume "On some Properties of the Earth" (1880) was presented to Prof. Langley. The portion specially pointed out to him discusses the papers of Pouillet. The quotation of a few passages sufficiently tells the result of the discussion.

Page 167.—"Apart from other considerations the 30·87 m. are slightly in default, because based on r, not on $r+h$, &c., as e is not $= o$."

Page 175.—"Pouillet finds that solar heat could annually melt an ice-crust of 31·34 m. all over the Earth; but as each point of its surface is in the mean only exposed half the day to this action, the heat which enters by it will possess double the energy calculated, or that of—

$$6{\cdot}44^{\circ} \times 2 = 12{\cdot}88.$$

He also saw that a larger quantity of heat than 6·44° daily must be received from without by any one square centimetre, or, putting it differently, by any one point of the Earth; and he saw the source of this heat in space, and calculated its energy equal to melting 26 m. of ice."

"He does not claim absolute correctness for his 26 m., which are to 31·34 m. as 5·22°: 6·44°. I intend to show that this heat is also solar, and is starting from the limits of the atmosphere also equivalent to 6·44°, or 6·55° considering refraction. If I be right, the effect exercised on any point of the Earth at the limits of the atmosphere will be in the mean of the day equivalent to—

$$6{\cdot}44^{\circ} \times 2 = 12{\cdot}88^{\circ},$$

and the energy with which it acts on such point, the Sun shining only for twelve hours on any point, will be—

$$6{\cdot}44^{\circ} \times 4 = 25{\cdot}76^{\circ}.$$"

Page 179.—"The effect of the Sun on any one point during twelve hours will be therefore equivalent to melting an ice-crust $31{\cdot}34 \times 2$ m. thick, over the whole earth."

Page 180.—"But why did Pouillet, starting from a false premiss, obtain an almost correct, or a correct, result? for we have only to add to his 26 m., almost corresponding to to 5·22° received at the surface of the real Earth, in which he erroneously thought he had included the air, the 1·22° from the limits of the air to the surface of the Earth to get the second 31·34 m. complete, corresponding to the 6·44° at its limits."

It is sufficient to say that, by an interpretation of Pouillet's observations different from his, put to the proof by analysing the work performed by the Sun, I made the Sun's heat effect equivalent to melting an ice-sheet 62·68 m. thick,—more still than the 57·7 of Prof. Langley, who did not observe at the limits of the atmosphere.

IV. PHYSIOLOGY AND ITS OPPONENTS.*

(Continued from page 603.)

MR. ROBERTSON then goes into the question of legislation for restraining cruelty to animals. He holds that in so doing "we deliberately interfere with the liberty of our fellows, and that by way of asserting not the rights of animals, but our own; for we do not claim for the hurt beast our own right of freedom,—we simply assert our determination to protect our own sensibilities in a case where we are convinced that the wounding of them

* Apologia or explanation of my last Article on Vivisection which appeared in a London Journal, September, 1, 1884. By a "WEAK WOMAN" who withholds her name.

The Ethics of Vivisection. By J. ROBERTSON. From "Our Corner." August 1, 1885.

(our sensibilities) implies an anti-social tendency in the aggressor. The discerning reader perceives, no doubt, that this is the form of argument used to support the blasphemy and Sabbatarian laws, and religious persecution generally." Still Mr. Robertson holds that "the prevention of cruelty by Law is about as safe, and stands on the same moral footing, as the prohibition of indecency." But the whole of this acute argument is really beside the question. For what is cruelty? Not the infliction of pain *per se*, but its infliction out of carelessness, for amusement, or for revenge. The most uncompromising opponents of the Bestiarian hubbub, ourselves included, would most willingly restrain every infliction of unnecessary injury on animals or plants.

Says Mr. Robertson—"We now come to the practical issue. Shall vivisection for purposes of medical research be suppressed on the score that the practice is demoralising whether useful or not; or shall we remove the restrictions at present laid on it?" We distinctly deny that the practice is demoralising. Both the men who engage personally in experimentation on living subjects and those who analyse and co-ordinate the results obtained may boldly challenge a comparison of their lives and characters with the most squeamish sentimentalist. To the outside public it cannot be demoralising simply because it is not, or rather was not, known. If it has *now* any demoralising effect upon the public—which we do not believe—the blame rests on the Bestiarians themselves.

Mr. Robertson continues:—"Those of us who have no fixed prejudice against legislation, as such, can see that there is a good deal to be said for the present arrangement of licenses, which puts a check on mere experiments in torture, and leaves a possibility of conscientious research." Here Mr. Robertson is doubly in error. Anyone who wishes to indulge in torture can do so with utter impunity at least on wild animals, provided he assigns as his motive "sport" or a wager. And the "possibility of conscientious research" is, on the other hand, extremely slender. If we consider that the applicant must first obtain a recommendation from either the President of the Royal Society or from the heads of our chief medical bodies, and then forward this document along with his application to the Home Secretary,—an overworked official, who as a rule has scant sympathy with Science,—we cannot fail to see that for an obscure uninfluential man to obtain a license is simply out of the question. But even men of known standing are often enough brought to a deadlock by this lamentable Act. As "Philanthropos" tells us,

"Dr. Brunton has been forbidden to seek for antidotes to snake-bites. Prof. Fraser has been checked in his attempts to study the nature of the poison used by the natives of Borneo upon their arrows; while Prof. Lister has had to leave England in order to carry on his researches." We have heard of a case where certain eminent medical men, wishing to study the poison of serpents, imported some very formidable specimens, and applied for a license; but before the necessary red tape was reeled off the snakes died. How many important inquiries are never undertaken in consequence of this Act cannot even be conjectured.

Mr. Robertson writes:—"At this moment a hundred forms of cruelty in the shape of 'sport' and the poisoning of vermin are not even menaced by Law; and Miss Cobbe admits that sportsmen are to be found among those who demand the suppression of vivisection. What we do is to put a rigorous check on the one form of systematic tampering with animal life which can be pursued from respectable or disinterested motive, and, instead of impartially proposing to extend this check to the less defensible forms, the Bestiarians simply clamour against the check as being a sanction. There could not be a more flagrantly nefarious tactic. . . . A benevolent passion is, in itself, no safer guide than passion of any other kind. At best the emotionalist has to rely on stress of language rather than ratiocinative persuasion, and at the worst the desired effect is compassed by *fearless fabrication*. Prof. Huxley is said to have complained of the 'profligate lying of virtuous women' in this connection, and I can testify to having seen and heard some of the lying from both sexes. I have heard one lady allege, in a semi-public meeting, that the Professor had declared animals to be automata who do not feel; and on challenge she could give no reference save a general one, which made it practically certain that she was simply misrepresenting his Belfast Address, in which he maintained the thesis that men and animals are alike automata, thus leaving the question of their comparative capacity for pain just as it stood before; and in which besides he expressly said—benevolently rather than logically—that he was strengthened in his rejection of the extreme Cartesian view by the recognition that it might encourage cruel treatment of animals."

A distinguished American contemporary regrets that the British "public did not and does not know enough about the matter to save itself from being misled by the reckless misstatements of irresponsible fanatics, and of certain

seekers after notoriety or salary"; and further, that "it has been possible for certain anti-vivisectors, by a persistent course of malignant vituperation and brazen mendacity, to produce a widespread belief," &c.

Of course if we were to give one-half the cases where Bestiarian advocates have dealt in untruths, ranging from exaggeration, *suppressio veri*, false insinuation, garbled quotation, &c., down to direct, intentional, and conscious falsehood, a monthly number of the "Journal of Science" would not suffice. The leaders of the "movement" well know that if they only persist in throwing dirt, some of it will stick. They know, too, that a false accusation may be made in very few words, whilst its refutation, requiring more, is less likely to be read. They have developed a fertility in deceit from which—even if Jesuitism were all that ultra-Protestant fancy pictures it—the wiliest Jesuit might learn much. But a couple of the most flagrant instances must be quoted. There is in Germany a certain Herr von Weber, who is the head of the Bestiarian movement in Germany. This Weber, a "Knight of high orders," as he styles himself, has written a book entitled the "Torture-Chambers of Science." In this he asserts (edit. 5, pp. 11 and 26) that Prof. Goltz did not make use of anæsthetics in his researches on dogs,—experiments which the Professor has described in a special work. Now in the Introduction to that work it is expressly stated that all the animals operated upon were, before the commencement of the experiment, brought thoroughly under the influence of chloroform! Weber cannot escape by pleading ignorance,—though that would be no legitimate excuse, since his work, the "Torture-Chambers," supplies abundant evidence that he has carefully studied the writings of Prof. Goltz. (See Prof. Goltz's "Rechtfertigung eines Vivisectors." Strassburg: K. J. Trübner.)

Hardened by practice, Weber went on to accuse a physician of having vivisected a man. This case was brought before the Courts, and Weber was condemned to imprisonment for libellous falsehood. His accomplice, the editor of a German Bestiarian organ, shared the same fate. These be the gods of Bestiarianism!

The Bestiarians have also falsely claimed Darwin, Cuvier, Bell, and Hyrtl as authorities on their side. In refutation we must refer to Darwin's letter to Prof. Holmgren, to Cuvier's *éloge* of Flourens, and to the works of Bell and Hyrtl. In short, mendacity may be pronounced the warp, and ignorance and the love of ignorance the weft, of the Anti-Vivisection Movement.

But to return to Mr. Robertson. He continues:—"Between such indulgences in reckless slander and the blunders into which they fall through extreme ignorance the defenders of the 'rights' of animals make a rather sorry exhibition. Miss Cobbe has been so egregiously absurd as to call a 'reflex action' a 'spasm of agony,' not knowing [or knowing but not caring to admit ?] that the *sine qua non* of the thing is the absence of sensation in the subject; and the Scottish Anti-Vivisection Society, a year or two ago, made a vehement attack on a Professor for the cruelty of certain experiments in which he had pointed out there was no pain at all. Anyone with the merest smattering of physiological knowledge would have known as much from the reports; but the superfluously sympathetic zoophiles conceived a decapitated frog and an amputated frog's leg as writhing in agony under the hands of the demonstrator. We see, then, that an excessive sympathy with animals is not at all necessarily an elevating influence, but may, like every other unregulated emotion, lead to all sorts of harmful conduct. What does the extreme attachment to animals, seen in so many anti-vivisectionists, really signify? Obviously a faculty for taking an extremely idealised, and therefore false, view of an animal's nature; for misconceiving, consequently, the relations of things in general; and for keeping the reasoning faculties in disastrous subjection to the passions. People admit in theory that any personal quality may become a vice merely by running to excess, but they singularly fail to apply the principle in detail. The zoophile flatters himself that his love of animals is a shining virtue, when in point of fact it is an extravagance which warps his moral nature, and makes him unscrupulous towards men in proportion as he is tender towards beasts. Take, further, the conception of the nature of cats and dogs exhibited in Miss Cobbe's pamphlet. There is no word there of the other side of the animal nature; and no recognition of the fact that the fidelity of cats and dogs is practically an unmoralised affection, being simply given to those near them without any save interested discrimination. [The Bill Sykes of fiction and the Peace of real life, along with unnumbered brigands, murderers, tyrants, and fools, are as dear to dogs as if they were saints or sages.] That is the typical attitude of the adorers of pets. . . . The pet-lover is not disturbed by his cat's cruelty to mice or his dog's ferocity towards other animals: these manifestations of character are serenely set down to irresponsible instinct; whilst the show of affection, which is equally a matter of instinct, is called a 'noble moral quality.'

In short, the zoophile's zoophily is mainly egotistic, 'my dog's devotion to me' being taken as the summing up of the dog's relation to life, though sympathy so far operates as to attribute like excellence to other people's dogs."

In good sooth the zoophilists fare but ill under Mr. Robertson's searching analysis. We have yet to examine the Bestiarian version or perversion of the "sport" question.

(To be concluded in our next.)

V. THE "TRADING-RAT."

By Mrs. E. D. W. Hatch.

WHILST borrowing an account of this curious animal from our valued contemporary, "The Popular Science Monthly," we take the liberty of adding certain comments. We do not call in question the facts as narrated by Mrs. Hatch, but we cannot help demurring to the interpretations here put forward.

"These interesting rodents are dwellers in the Rocky Mountains and adjacent hills, and are known among us by various significant names, as mountain-rat, timber-rat, and trade-rat. The first, of course, refers to their native home; the second to the sound of their gnawing, scarcely to be distinguished from the sawing of timber; and the last to their peculiar system of barter or exchange, so curious a habit that it is doubtful if any other animal has ever been known to practice it while in a wild or untamed state.

"One of these rats being caught in the house, attracted notice by his size: I measured him, and found his body 8 inches long; tail, 8 inches; around his body, under his fore legs, 7 inches; ears, 1½ inches; fur beautifully fine, grey, with a darker shade, nearly black, running lengthwise down his back. He was very plump and fat, but I omitted taking his weight.

"They haunt houses and camps near the hills, but seldom, if at all, those a few miles away. The peculiar trading

characteristics natural to this little merchant, its habit of exchanging goods without a 'by your leave,' wise ways, and queer tricks seem far more like reason than instinct." [We need scarcely remark that we do not accept the common notion of "instinct" as an antithetical substitute for reason.] "A few incidents which came under my own observation will illustrate this characteristic. Some men, passing through the country, camped in a deserted cabin, and, before wrapping themselves in their blankets for the night, they placed their bread for breakfast in a pan near the fire. On rising, to their dismay, not a crumb of bread was left in the pan, but it was filled with old scraps of leather, chips, bones, mouldy beans, rags, &c. Searching, they found, high up on a partly broken shelf, in an old tin can, their bread packed away with old bacon-rinds, bones, rags, and other trash.

"In the house of one of my neighbours these mischiefs carried away a lot of Indian meal, and in the meal-box deposited a quantity of bird-shot, which, mixed with the remaining meal, caused the housekeeper great dissatisfaction. In the same house a trunk was accidentally left open one night: in the morning a quantity of rice, bits of dried fruit, and some oats, were found mixed with loose coral beads and other small trinkets. It was an exercise of patience to separate the articles, as may be readily imagined.

"With these traders exchange is no robbery, and distance small hindrance; they travel from their homes and go from barn to house, from loft to cellar, and through living-rooms (noiseless when acting as porters), with great speed and impartiality. A sheep-herder, returning to his camp from a town 30 miles away, brought home a fine new hat; placing the box on his table, he went away for the night. Returning, he found the box had been entered, the crown of the hat eaten entirely round, and the box then filled with wool, flannel rags, remains of food, wheat, and dried fruits. There was a sudden forced abandonment of that unsurveyed 'squatter's claim.'

"Some ranchmen were gone mowing for several days, camping away from home. After their return they soon learned that their quarters had not been unoccupied during their absence. A nest composed of wool and rags filled the flour-sieve left upon a shelf: next beside the sieve stood the coffee-box; in it had been left about a pound of good coffee; now the box was filled to the top, mixed with the coffee, mouldy crusts, bones, and rinds, that had been scattered about the place. 'When I threw it all out,' said the man,

who was telling me, 'provoked as I was, I could not help noticing how *prettily* the nest was made up of gnawings of an old blue army-overcoat, red flannel shirt, and many white rags, put together so nicely and made so soft within.' This morning, going to the store-house for a lamp-chimney, I found an ordinary glass chimney packed close with straw, grains of rice, oats, wheat, a few beans, and chips.

"The mischief these rats can do in a single night is almost incredible. One, getting into a lady's room, stripped her house-plants of every leaf and blossom, and hid himself behind the wardrobe, where he was found next day, with a most singular accumulation of goods,—among them many bits of paper, a quantity of raisins, a box of matches, some candle-ends, gnawed postage-stamps, and a lot of odds and ends. Nothing seems to come amiss, and they are particularly fascinated by anything that glitters, often carrying off knives, spoons, watches, and silver, and hiding them effectually.

"They are 'good providers,' and in the fall build their nests, and fill them with stores of eatables, the result of persevering foraging expeditions for their families before winter sets in. Under a large cotton wood-tree on a side-hill, partly underneath a fallen trunk, a party of us found a mountain-rat's nest. It was built up nearly 2 feet in height, the top or roof covering it sloped on all sides to shed rain or snow: tearing it to pieces, we found it was built closely of grass, moss, chips, bones, and many leaves of the cactus (which grows plentifully among the rocks); how they could cut off and convey this thorny stuff, working it up with the other material, in the close covering, is hard to understand. Away down, running in almost under the log so well built around, out of the reach of any possible moisture or cold, a clever little bed of wool was found, made for the young rats. This wool, of which there was a quantity, must have been collected bit by bit from the weeds through which the sheep passed, and from their corrals.

"To reach this nest in the rat's house there was quite a long, circuitous passage, entrance close to the ground, on the south side,—a little den or hole to crawl through, In a little heap outside, not yet carried in among their provisions, but lying close by, we found more than a quart of fine fresh-looking potatoes, brought from our own garden; and it is an unsolved mystery how the potatoes were taken there, with not a scratch or mar upon them, or the skin bruised or broken. The garden was a hundred feet away, considerably lower down, and a stream of water, an irrigating ditch, to

be crossed to reach it. One person suggested that the rats might have rolled them all the way, and across some poles thrown over the stream.

"Destroying this nest, a couple of rats darted up the standing tree, and there we were surprised to find another nest had been commenced in the forks of the tree. We destroyed this nest also; but here comes in another mystery, a puzzling question—How could the rats climb that tree and carry up stores for the winter? This nest was probably 25 or 30 feet from the ground.

"I asked a ranchman a few days ago, who was talking about them, if he was afraid of them (I meant of their bite). 'No,' said he, 'and they are not afraid of me; they have waked me many a time, sitting up on the floor of my cabin and rapping their tails like a dog!'"

Mrs. Hatch adds:—"I have already spoken of their great strength and celerity of movements. To an observer these traits are a never-failing surprise. If a light is steadily burning, and all is quiet, they are easily watched, darting backwards and forwards, carrying goods each way, and often making long trips. I have known them to bring nails, bits of iron, screws, and other things left about the sheds, to the house from some distance, placing them on shelves, boxes, or kegs, just as they fancied, but all in some selected spot, carrying back from cellar and store-house dried prunes, apples, rice, and all kinds of eatables. If working in the dark the striking of a match, a slight noise, or a sudden light will cause them to vanish like a flash.

"They seem, too, to have a fancy for certain colours, particularly bright red, and will soon make away with garments of this colour and attach them to their nests. There may be something attractive in the dye, but, knowing their partiality for glittering, shining objects, I am inclined to think that they have also an eye for colour."

We must now endeavour, in examining this account, to distinguish between fact and inference. We may premise that we should gladly welcome the demonstration, in any species of the lower animals, of the idea of exchange,—that of property, real and personal, is indisputably manifest in several.

The facts really before us are that these "trading-rats" have been found, in many instances, to bring as well as to take away. If they take certain articles from a given place, A, to another, B, they are described as bringing to A other articles, either from B or from some other place.

Here the question first arises, Do they never take without bringing, or bring without taking? Upon this point Mrs. Hatch does not throw any decisive light. But she mentions that the rats had conveyed away from her garden a quart of potatoes, and left them near their nest 100 feet away. Had they brought anything in return? But the main question is, Do these creatures at all conceive that they are making any return for what they carry off? After very carefully reading the narrative, we must confess we can see no evidence to that effect. Their operations, as here narrated, seem mainly to consist in displacing articles already existing on the premises. Now this displacement, or in human eyes *mis*-placement, is certainly not peculiar to the rat in question. It is observed in other Muridæ. Years ago we were much annoyed by the conduct of the grey or Russian rat in this way. We were conducting some experiments in a chemical works in the country, and found that the laboratory and the offices swarmed with rats. One morning we found that several sheets of filter-paper had been taken away from an ill-made drawer in which it was kept; that much of the remainder was torn, greasy, and generally dirty, and that there was a quantity of palm-oil deposited in the drawer. This oil had been taken from a cask in a store-room a few yards from the laboratory, and thither a part of the filter-paper had been conveyed. Their motive for carrying off the filter-paper is not hard to trace; but why they should have brought the palm-oil, which they could have nibbled just as well in the store as in the paper-drawer, no one could conjecture. We have further heard of, and even seen, other instances where mice or rats have deposited, in nooks and corners, rubbish of various kinds, not suitable either for food or for lining their nests. The only motive we can imagine for such actions is a propensity for "meddling and muddling," and this view seems to suit very well the cases narrated by Mrs. Hatch.

From a human point of view these "trading-rats" must be counted a most serious nuisance, since they not merely plunder, as do monkeys, cats, magpies, ants, and other creatures, but by their exchange transactions they spoil more than they carry off. Hence their extermination should be aimed at in every practicable manner.

VI. THE RESULTS OF RECENT RESEARCHES ON MALARIA.*

By Dr. HANS SCHŒFFER.

ALL experience and observation hitherto made on the nature of malarial diseases points very decisively to the fact that its true cause must be sought in the soil of those localities in which such diseases are prevalent.

If we search for the factors and the circumstances which favour the development of the supposed exciter of the malarial process, we are struck by the accordant statement that malarial disease occurs endemically, especially where the physical condition of the soil or that of the subsoil prevents a rapid efflux of the water.

Such conditions prevail most decidedly in swamps. Here accordingly it is found that malaria prevails most intensely when, in the dry season, the ground is covered only with a shallow layer of water, and is here and there laid bare. As long as the swampy ground is entirely under water the generation of malaria is trifling or altogether wanting. Hence we do not find malaria in all swampy regions. In hot climates especially there are extensive swamps where it is practically absent.

[As an affirmative instance may here be mentioned the Dismal Swamp of North Carolina, where "fever and chills" are less prevalent than in the fairly dry cultivated lands of the same State.]

On the other hand, malaria is encountered not merely in swamps, but also in well-watered valleys exposed to frequent inundations, where, in consequence of their position, the waters cannot drain rapidly away. Such conditions are found in clays and alluvial soils, which always contain a sufficiency of water, at least in their lower strata.

Under other circumstances malaria occurs, even on apparently very dry ground, when beneath the porous surface-soil there lies an impervious subsoil. Thus foci of malaria may occur in elevated districts, and even in mountain chains. Thus they exist in the Apennines of Tuscany at the height of 1100 feet, in the Pyrennees at 5000, and in Peru up to 10,000 to 11,000 feet. In Italy especially, according to an

* A Discourse delivered before the Vienna College of Physicians.

approximate calculation, two-thirds of the malarious regions occur on hills, and even on mountains.

Experience teaches us, therefore, that malaria occurs only when the surface-soil dries up to such an extent that the atmospheric air is enabled to penetrate to a certain depth—*i. e.*, to those strata which retain their moisture even in the hot season. The access of atmospheric air is of such importance that an old malarial soil can be covered over by natural or artificial deposits, and in a manner buried. It then produces no malaria as long as the superimposed deposits form a sufficiently compact layer. But the malaria reappears when the swampy soil is separated from the atmosphere only by a thin loose stratum of soil, and especially when by any contingency a direct communication is opened up between the atmosphere and the malariferous subsoil.

[Here belong, possibly, the pestilential outbreaks which have been recorded as following earthquakes.]

From this point of view we may regard the appearance of malaria on turning up so-called virgin soils, in constructing railways, canals, harbours, fortifications, &c., in consequence of the inversion and disturbance of the earth occasioned.

Such and similar observations show that the malarial germ inheres in the soil. They prove also that it requires the mediation of the atmosphere in order that it may be developed, or at least extend itself. The production of malaria can therefore occur almost everywhere—in swampy soils, and in soils apparently very dry; in soils rich in organic putrescible matter, as well as in such as are almost free from such substances.

The word malaria—bad air—was accordingly accepted almost universally, in order to indicate the cause of intermittent and malignant fevers. In consequence of more recent investigations we imply by it an agent which may infect every kind of soil, whatever its geological origin or chemical composition.

The production of malaria takes place, however, only in certain well-defined conditions, and there are in this respect three factors, whose co-operation gives rise to the poison:—

1. A fairly high temperature.
2. Permanent moderate moisture of the soil.
3. Access of the atmospheric air to the moist strata.

[Unfortunately these are at the same time the elements of fertility, so that Nature seems to give man the grim choice between famine and pestilence.]

As regards the influence of temperature, it may be mentioned that for the most part malaria does not occur beyond 63° N. latitude and 57° S. latitude; from these limits it increases towards the Equator, with a gradual increase both in intensity and extent.

[If we consider that in the Southern Hemisphere there are mere desolate islands, such as South Shetland at 57° latitude, we shall not lay great weight upon the southern limit above given. But according to many authorities malaria is much less general than in the Northern at such latitudes as 40°, and even 30°.]

Here the question is not so much the mean annual as the mean summer temperature. If, in a region where malaria is generally frequent, the mean summer temperature is exceptionally low, *e.g.*, below 68° F., the malarial forms occur slightly or not at all. If the temperature rises they become more intense.

[It must here be remembered that up to the earlier part of the last century malaria was regularly present in Lincolnshire and other parts of the eastern coast of England, though a mean summer temperature of 68° F. is certainly very exceptional.]

The second factor necessary for the development of malaria in the soil is the access of air to the malariferous strata of the soil. If in low grounds there often occur inundations which carry with them and deposit much earth, there is formed by degrees an accumulation of soil which, if thick and dense enough, cuts off the access of the air to the subsoil, and thus stops the development of malaria. This is a form of sanitation which often takes place without human aid [but which is sometimes imitated by man. "Warping," as it is called, is proposed as a means for the sanitation of the malarial low grounds near Rome].

If, inversely, such old buried malarial foci are laid bare and turned up in the course of engineering or agricultural operations, the fevers reappear. Hence we may conclude that the malarial germ requires for its development the access of atmospheric air; it is an ærobic organism.

With the importance of the access of air to the malarious subsoil the existence of moisture is closely connected. The occurrence of malaria in relatively dry, elevated regions, teaches us that a very moderate degree of moisture is sufficient for the production of malaria.

[Here then comes a difficulty: how can we drain the subsoils sufficiently without letting in the air?]

If for a long time no rain has fallen, so that the soil loses

all its moisture by evaporation, the production of malaria ceases, and decidedly malarious soils may remain harmless during the whole course of a hot dry summer. This may be called a natural hydraulic sanitation. But if the ground is then moistened by rain, of even brief duration, there may occur—so to speak—an explosion of malaria.

With us a wet spring and summer, followed by heat, are favourable conditions for malaria. If before the commencement of the hot season the ground has been thoroughly soaked in rain, and if it is then exposed to an elevated temperature, so that it dries on the surface, the development of malaria begins. In some cases it is even found possible to show a direct proportion between the extent of the endemic and the quantity of rainfall. Thus it is known that both the malignity and the generality of malarial fever are directly as the rainfall in the past winter and spring. Not that the great quantity of moisture has any direct influence, but that the moisture of the soils persists longer, and with it the endemic.

A short cessation of the production of malaria in the soil does not suffice to destroy its cause, the disease-germs in the soil. They remain merely in a latent condition, and can again develop their destructive action as soon as the necessary conditions are reproduced.

The attempts hitherto made for the sanitation of malarious districts have been guided by the opinion that malaria originated only in swamps or swamp-like localities, and where masses of organic refuse were slowly undergoing decomposition. Since then it has been held sufficient for sanitary purposes to promote and regulate the constant efflux of the water, thus eliminating one factor only.

In fact thermic sanitation, such as is produced by Nature in winter, is impracticable, because we cannot diminish the action of the solar rays. [To do so would be suicidal, were it in our power.] Hence we can only act upon the two remaining factors.

The systems of hydraulic sanitation are very various, since the problem of removing the moisture of the soil during the hot season admits of various solutions, according to the locality. Drains, open or covered, may answer the purpose of conveying large quantities of water from the malarial soil. In other cases the natural drainage of the soil sucks out and carries away the subterranean moisture. Thus the level of the "ground-water" is lowered, so that it can no longer reach and keep moist the malarial strata which are exposed to the action of the atmospheric air.

Those sanitations which are aimed at by laying malarial districts bare of trees are of a purely hydraulic nature. [Surely some of the most malarial districts of the world—such as the neighbourhood of Rome, many parts of India, Peru, &c.—are distinguished by the absence of woods.] Whilst we formerly spoke of the action of woods in purifying the air and filtering out the malaria, the conviction gains ground that, as the destruction of the woods removes a hindrance to the direct action of the solar rays upon the soil, to remove all moisture during the hot season in districts with a shallow soil would improve their salubrity. [The desiccation of the subsoil by the action of the sun's rays upon the surface is an exceedingly slow process. Trees which send their roots down to the lower strata, and suck up large quantities of moisture, are more effectual than the direct action of the sun on the surface.]

So long as the nature of malaria was sought for in the "miasmatic, putrid exhalations of the swamps," this view of the protective action of forests had a similar meaning to the plantations of Eucalyptus, whose powerful aroma was to destroy the poisonous exhalations. But favourable as is the action of rapidly growing plants in promoting the drainage of the soil, the experiments with the Eucalyptus in Pola and Italy were not satisfactory. The trees are very sensitive, and easily suffer from frost. [This, of course, does not apply to climates warmer than Italy.] They are often damaged by the wind, and they are costly. A specific action can scarcely be admitted, since there are in Australia entire forests of Eucalyptus in districts where malaria is endemic. [Without admitting half of what has been said concerning the efficacy of the Eucalyptus, we may still ask Why should Australia, in a lower latitude than Italy, suffer so much less from malaria?] It cannnot be valued more highly than other water-absorbing plants, such as the sunflower.

VII. POISON-SECRETERS.

By J. W. SLATER.

ONE of the most interesting phenomena in the organic world is the power which many species—vegetable as well as animal—possess of elaborating poisons. These poisons differ among themselves most widely in almost every imaginable respect, and present a host of unsolved problems, to some of which I shall have occasion to refer. But, with few exceptions, they surpass the mineral poisons in deadliness. Arsenic and corrosive sublimate are inert or mild as compared with the aconitine of the vegetable world or the "cobric acid" of the animal kingdom.

This fact, it may be remarked in passing, throws a somewhat novel light on the statement so commonly found in advertisements of quack medicines, that they, being of "purely vegetable origin," may be taken without danger.

The first point which strikes us in glancing over the long roll of organic poisons is, that they fall naturally into two great classes, the offensive and the defensive. This distinction lies not in the poisons themselves, but in the circumstances that the creatures elaborating the former class are provided with some special apparatus by means of which they can introduce the deadly secretion into the body of their prey, or of a supposed enemy. The purely defensive poisons, on the other hand, exist in the body of some plant or animal, and are perfectly harmless if let alone. But as soon as any animal devours, or attempts to devour, or in some cases merely touches the poison-bearer, it suffers pain, sickness, or death. Such defensive poisons are most common in vegetals, where they occur sometimes in the entire plant, but sometimes only in one particular part, such as the seeds or the root, other parts remaining wholesome.

Certain animals also are in possession of defensive poisons. The common toad is a striking instance. This creature has undergone strange vicissitudes of reputation. In the olden time it was unhesitatingly ranked as malignantly venomous :—

> "Toad that under the cold stone
> Days and nights has thirty-one
> Sweltered venom sleeping got."

Then as this animal became better known, and was found to be utterly devoid of any appliance by which poison might

be instilled into the human or other animal body,—such as a sting, a rostrum, grooved teeth, or indeed teeth of any kind,—its innocence was distinctly proclaimed. And innocent he undoubtedly is, to man. He may be handled with absolute safety, as we know from abundant experience.

Still, for all this, the toad is venomous. Everyone who knows a toad from a frog must have noticed the pustules with which the skin of the former is in many parts covered. These pustules secrete a watery liquid, the chemical composition of which is by no means fully known, but which is unquestionably poisonous. In proof, if the courteous reader thinks proper to apply a little of this liquid to his lips, or to his eyeball,—painful experiments on an animal which may be performed without the gracious permission of the Home Secretary, but which I do not recommend,—he will feel a very considerable degree of irritation, and in case of the eye he may very probably require medical advice. Several other Batrachians are similarly provided. They are utterly unable to bite, sting, or otherwise insert venom into the human system, but the secretions of their skins or of their pustules are unquestionably poisonous, and if applied to a wound, or to a mucous membrane, injury will result. Even the common frog in his unskinned condition is not quite to be trusted in this respect.

My late friend Thomas Belt mentions a red and blue frog, common in Nicaragua, which is avoided by fowls and ducks. He managed to induce a young duck to snatch up one of the little frogs. "Instead of swallowing it, however, it instantly threw it out of its mouth, and went about jerking its head as if trying to throw off some unpleasant taste."

But of all Amphibians the earth salamander, *Salamandra terrestris*, enjoys in the countries where it occurs the most evil reputation. It was supposed to be able to kill by a mere touch,—according to some rustic sages even by a look,—and to render vegetables unwholesome merely by creeping over them. In the second quarter of this century it was far from uncommon near mountain streams on the frontiers of Bohemia, Moravia, and Hungary, where its jet-black colour, relieved by irregular yellow or orange blotches, made it a very conspicuous object. To pelt this inoffensive creature with stones from behind a tree-trunk was considered among the village boys of those parts a very heroic feat.

Not a few fishes, mollusks, and crustaceans enjoy also the repute of being dangerous, or even deadly, if swallowed,—

and this with perfect truth. But concerning these animals there remains very much to be ascertained. In most of these cases we do not know whether the poison is physiological, *i.e.*, existing in the animal when in its normal condition, or pathological, developed only in consequence of some disease. Indeed when the fish, &c., are not consumed immediately on being taken from the sea, there is a third possibility,—that the poison depends on incipient decomposition, and is probably a *ptomaine*.

The number of insects which may prove very dangerous, if eaten, is great,—a consideration which ought to be duly weighed by those who recommend insects as an article of human food. How many species develop cantharidine, the active principle of the so-called Spanish fly, is far from having been thoroughly ascertained. An unfortunate circumstance is that cantharides, though poisonous to all mammalian animals with the exception of the hedgehog, are eaten with impunity by frogs and several kinds of poultry, including, I believe, the common duck. The flesh of such animals becomes poisonous to man and to ordinary carnivorous animals. Inflammation of the bladder is not uncommon among French soldiers in Algeria, in consequence of their consuming frogs which have fed on these insects.

Instances are on record that poultry, including ducks, have been poisoned by feasting on the "Colorado beetle" (*Leptinotarsa decemlineata*), and by some kinds of caterpillars not properly identified. It is, indeed, very probable that caterpillars feeding upon poisonous plants will prove deadly. Such caterpillars are generally very conspicuously coloured, as if in warning.

We have now to consider the question, Of what use are defensive poisons either to plants or to animals? It is contended that the death of the devourer can be of no benefit to the plant or animal devoured, and will not serve as a protection to others of the same species, since dead birds and dead insects, like dead men, tell no tales.

But against this argument we may set the indisputable fact that unwholesome plants, insects, &c., are very generally avoided by such species as would otherwise be likely to prey upon them. It by no means follows that a fatal dose will always be taken. Differences in the quantity consumed, in the previous state of the stomach, as full or empty, and in the constitution of the eater, cannot fail to make themselves felt. He may come off with an illness, more or less severe, but not fatal, and will in future shun the cause of his sufferings. In whatever way it may be effected, such

knowledge spreads, just as does that of any new or newly-recognised source of danger. Hence it is not unfair to conclude that the possession of defensive poisons is a safeguard to the animal or plant in question. That this protection is not universally efficacious must be admitted. The poisonous nature of the foxglove does not save its leaves from being riddled by snails. The fact that they are saturated with cantharidine is no safeguard to certain beetles against being munched by hedgehogs and gobbled by ducks. If we ask the elder naturalists for an explanation of these cases, they tell us that the snail is specially adapted to keep down the growth of the foxglove, and the hedgehog commissioned to hold the Spanish fly in check. If we turn to the advocate of Natural Selection, he will inform us that the Spanish fly has developed a poisonous property by which it defies its enemies, or, in other words, that it has survived in virtue of having developed such property, whilst its assailant, the hedgehog, survives (or at least possesses a certain advantage) in virtue of having developed an immunity against this poisonous property. I can scarcely see that the latter answer is more satisfactory than the former. Both accept the notion of a game of cross-purposes,—of an Agency undoing with one hand what it does with the other. Neither tells us why one plant or animal should be protected rather than others, or, if protected at all, why this object should be effected in one case by poisons, and in another by a nauseous smell or taste. Do such points depend on mere chance?

In plants, at least, evil scents and flavours often prove a most efficient safeguard. I know of no plant which enjoys such complete immunity from slugs, caterpillars, and aphides as does the Escholtzia, free from poison, but saturated with an intensely bitter principle.

But I must now turn to the offensive poisons,—those which, by one or other means, are introduced into the body of some victim against its will. As usual in Nature, there are here marks of continuity,—intermediate links,—so that we may often stand in doubt to which class a given poison is to be referred.

We read of plants—though more precise knowledge is here needed—which can injure by odours emitted, or by the dew which drops from their branches during the night. The sensational accounts of the upas-tree of Java, and its death-valley, are now relegated to the sphere of the mythical. But it seems possible that persons of susceptible constitutions may be injured by sitting, and especially by sleeping,

under the shade of the yew-tree. But here, and still more in the case of the *Hippomane mancinella* of Cuba, and of certain other tropical trees, further investigation is needed.

Among animals an intermediate position seems to be taken by the venomous hairs of many caterpillars, which contain and emit formic acid in a very concentrated form. A bird or other animal seeking to make a prey of such caterpillars is almost certain to receive envenomed wounds. But the hairs become detached as the caterpillar creeps about, and are carried away by the wind. The nests of some of these species should be approached from the leeward side, or they may produce painful inflammations on the face, and if carried into the lungs they may prove fatal. Certain oak-woods in France and Germany are shunned by the country people during summer, on account of these insects.

As a further stage in the direction of offensiveness, we may note the projection of noisome or corrosive secretions to some distance. Thus the "bombardier beetles" (*Brachini*) emit an acid vapour or highly volatile liquid, which instantly evaporates, accompanied by a faint explosion. *Cychrus rostratus* projects a drop of concentrated formic acid to the distance of some inches. If this liquid touches the face it causes a painful blister.

Passing over a number of insects which if handled or alarmed emit liquids of unknown composition, we come to the skunk. The abominable secretion which this creature projects if annoyed may fairly rank among poisons, since it produces violent sickness if the fume is inhaled, and since a drop, entering the eye of a dog, has been known to produce blindness.

But we must now hasten to those creatures which can employ their poisonous secretions as the means of offence by the instrumentality of special organs.

Among these we find only one group of plants,—the nettles. If touched they sting, by conveying through their hollow hairs minute drops of formic acid. Such is, at least, the poison present in the common nettle of Europe; but some more potent poison—perhaps a homologue of formic acid not yet examined—must be present in certain tropical species. The effects of *Urtica urentissima*, of Timor, may last for months, and may terminate fatally. The "devil's leaf," of Ceylon, has produced almost instantaneous death, whilst an Australian nettle, about which exact information is lacking, is said to be rapidly fatal to horses,

whilst to man it is not more formidable than the English nettle.

The possession of poisoned weapons is very common in the animal kingdom, chiefly among the Arthropods, much more rarely among the Vertebrates. Among the latter it is met with only in two of the lower classes, the fishes and the reptiles. No warm-blooded vertebrate—in other words, no bird or mammal in its normal condition—possesses a sting or poison-fangs.* It may be added that no such creature is even defensively poisonous. Now as the power of secreting and instilling venom, like that of spinning silk, would undoubtedly be useful to certain birds and mammals, it becomes probable that, as we ascend the animal scale, the power of evolving varied chemical compounds and of the necessary organs for their use becomes feebler.

It has been asked, Why are all poison-armed animals carnivorous? Some have asserted that to them poisons are of greater service than to plant-feeders, as giving them facilities for the capture of their prey. Others have suggested that poisons may be secreted more readily from animal than from vegetable matter. But this dispute is at once cut short by the fact that the honey-bee and its near allies, feeding on honey, pollen, and occasionally on the juices of fruits and the sweet sap of trees, are also armed with stings.

One of the most remarkable features in the poison-bearers is the diversity that prevails not only in the apparatus employed, but in the poison itself. Thus in the venomous fishes we find certain of the spines of the dorsal fins hollow, and placed in communication with a poison-bag or gland at their base. In the venomous lizard, *Heloderma*, we have the ordinary teeth. In poisonous serpents there are special fangs provided with a duct, and receiving their supply from a gland which is a modification of one of the ordinary salivary glands.

We may here consider that the saliva of the dog, when modified by a certain disease, becomes deadly, and remember Oken's hypothesis, that the normal saliva of all animals seems—in addition to its chemical functions—to have the task of extinguishing the molecular life in the animals or plants eaten.

But there is one serpent which, if Australian reports are to be depended on, instils its venom in a quite exceptional

* I reserve the doubtful case of the *Ornithorrhynchus*

manner. It is said to have, at the extremity of its tail, a hard, bony sting, with its accessory poison-gland. In attacking it seizes hold of its enemy with its jaws, and, curving up its body, drives the sting into any part within reach. I very much wish that this strange story might be either verified or refuted.

In the venomous Hymenoptera—bees, wasps, and hornets—the weapon is a modification of the secondary generative organs. The sting of the scorpion, though situate at the posterior end of the body, is totally dissimilar to that of the bee. It is a special development of the extremity of the body. The spiders envenom by means of specialised antennæ, and the centipedes by peculiarly developed fore legs which have lost their progressive function. In the suctorial insects, such as Hemiptera and certain Diptera, the venom is conveyed by the tube through which food is taken up.

An interesting feature is that where silk-spinning and poison-secreting occur in the same animal the organs for these two purposes exist at opposite extremities of the body.

Concerning the chemical nature of the venoms secreted by different animals little definite is known. The secretions of species not very remote from each other are by no means identical. The poison of the bees and the ants is acid, that of the wasps and hornets alkaline.

Concerning the venom of serpents, it is not yet decisively known whether we have here to do with a chemical individual,—such, *e. g.*, as a ptomaine,—or with an organised virus, like that of plague or cholera, capable of reproducing itself and multiplying in the body of the victim. Here authorities differ, and crucial experiments are on British soil almost impossible, thanks to the Bestiarian agitation.

For young naturalists residing in tropical and semi-tropical countries there is here a splendid field for research.

VIII. STRASSBURGER'S THEORY OF GENERATION.

E. STRASSBURGER had added to his former numerous researches on the history of the development of organisms a new and important investigation, in which he attempts to solve the problem of generation. His researches which have been made upon plants, though they are to a great extent applicable to all living beings, have been published as a separate work,* and are being discussed in the "Naturforscher."

From the author's observations on the process of fecundation in phanerogamous plants, there appear three facts:—

1. The process of fecundation depends on the conjugation of the nucleus of the male sperm-cell on its introduction into the ovum, with the nucleus of the female germ-cell or ovum-cell.
2. The plasma of the fecundative cells not belonging to the nucleus (cytoplasm) takes no part in the process of fecundation.
3. Both sperm-cell and germ-cell are true cell-nuclei.

As for the efficacy of the cytoplasm in the process of fecundation, it serves merely as a vehicle in order to convey the sperm-cells to the place of their destination. It plays here, therefore, the same part as do the cilia of the sperm-atozoids of cryptogamous plants.

Hence, if we generalise the relations established for phanerogamous plants by extending them to all living beings, the offspring can inherit the properties of its parents solely by the mediation of the cell-nuclei. Therefore the specific distinctions of the organism must have their foundation in the properties of these cell-nuclei. Each cell-nucleus contains (as it is already well-known), as its framework, an anastomising manifold intertwined thread, the so-called "nuclear thread," consisting of a transparent substance, the nucleo-hyaloplasm, in which are imbedded numerous small granules, the nucleo-microsomes.

Between the windings of this nuclear thread there lie the nuclear corpuscles (nucleoli), one or more. The entire

* Neue Untersuchungen ueber den Befruchtungs vorgang bei den Phanerogamen as Grundlage für eine Theorie der Zeugung. Jena, 1884.

framework is placed in a nuclear cavity filled with the nuclear fluid and surrounded by the nuclear wall, which Strassburger regards as a membranous layer of the surrounding cytoplasm. This nuclear wall is internally in contact with the windings of the nuclear framework, but he does not assume a direct continuation of the cytoplasmic threads into the framework of the nucleus. The reciprocal action between the stationary nuclei and the cytoplasm is therefore merely dynamical,—*i.e.*, it takes place without any transportation of matter. The nutriment which the young cell-nucleus requires after fission, to complement its mass, issues in a soluble state from the cytoplasm, and passes through the nuclear wall. When a division of the nucleus is to follow, the nuclear threads contract and the microsomes coalesce with each other to form disk-shaped structures. A portion of the hyaloplasm also contributes to the formation of these disks. This portion of the hyaloplasm which has passed into the microsome disks must have been present in the stationary cell-nucleus as an active nutrient plasm (nutritive nucleo-plasm). The residual portion of the hyaloplasm, which may still be detected between the microsome disks, and which probably covers them with a delicate coating, is to be regarded as active, formative plasmas. This formative nucleo-hyaloplasm corresponds with Naegeli's "idioplasm,"—*i.e.*, that part of the plasma which contains the hereditary tendencies.

That we must also distinguish a nutritive and a formative hyaloplasm in the cytoplasm, where a firm texture is wanting, seems to follow from the processes in nuclear division. In this operation the cytoplasm penetrates into the nuclear cavity and produces the spindle-shaped fibres, which, when the separation of the filial nuclei has taken place, remain as connective threads, and allow of the formation of the cell-plate from which the young partition-wall proceeds. Strassburger is inclined to regard these threads as the formative plasma of the cytoplasm. The equatorial parts of such threads remain as exceedingly delicate connective threads in the partition-wall, and maintain the connection between the single cytoplasts of the body of the plant.

This formative cyto-hyaloplasm is, in a certain manner, idioplasm of the second order. It is to be regarded as the organ of adaptation, whilst the cell-nucleus represents the conservative principle in the organism. As far back as 1866 Haeckel came to the conclusion that the nucleus mediates the transmission of the hereditary characters, whilst the

external plasma is concerned with adaptation. Molecular excitements are propagated from the nucleus-cell to the surrounding cytoplasm, which, on the one hand, control the processes of the transformation of matter in the cell, and, on the other, impart the peculiar character of the species to the growth of the cytoplasm conditioned by nutrition. The cytoplasm in return reacts upon the cell-nucleus, exciting its divisions and determining its nutrition.

In opposition to Nussbaum and Weismann, and in accord with Naegeli, Strassburger assumes that the germinal substance in the course of ontogeny does not pass unchanged into the organism (the substances determined for the germinal cells being early separated from the remaining substances of the body), but that they are produced anew from the modified idioplasm by a process of reverted development. In a certain sense the nuclear substance fulfils the conditions which Weismann demands from germinal substance, for it passes through the body in a separate condition, in so far that the dynamic influences proceeding from the cytoplasm and acting upon it have little influence upon the specific attributes of the nuclei. The individual acquired properties remain connected with the idio-cytoplasm, and are transferred only along with this, as in the improvement of plants. In common with Weismann, Pflüger, and Naegeli, Strassburger opposes the exaggerated importance atttributed to individually acquired properties, and, with Naegeli, he seeks for the causes of the changes of the organism not in outward, but in inward factors, namely, in the molecular forces inhering in the substance.

In copulation only those elements of the generative cell-nuclei become mixed which are not morphologically differentiated. The nuclear threads on both sides do not coalesce, but merely apply themselves to each other. Not until the fission of the germinal nucleus does the process of coalescence ensue in the secondary nuclei. In the germinal nucleus preparing for division the framework contracts to a short thread, which is resolved into segments. These again are split up longitudinally, and these halves of each segment are distributed equally to the two secondary nuclei.

In these the nuclear thread segments coalesce with their ends to a single nuclear thread, which is thus composed half of segments derived from the father and half of those springing from the mother. These pieces must have been again derived each from both grandparents. It is clear that both these parts become the smaller the more remote the generations to which they belonged. The portions of the

thread derived from the same ancestral pair are distributed in small fragments through the entire thread. If, then, accidentally several segments derived from the same progenitor are brought together, they acquire a certain influence which can occasion in a given part of the organism a phenomenon of reversion. The more remote the generations from which they are derived the smaller are the segments, and the less is the probability of their manifestation. But Strassburger, like Naegeli, refers the ordinary phenomena of atavism, which consists in the fact that some given property overleaps one generation to reappear in the next,—not to the re-union of segments of the nuclear thread, but to a latency of the phenomena in question.

Both the sperm-nucleus and the ovum-nucleus unite the properties needful for the formation of both sexes. There are no morphological facts known which could necessitate the assumption of a functional difference in the two conjugated cell-nuclei. The view that the specifically male elements are previously expelled from the sperm-nucleus, and the specifically female elements from the ovum-nucleus, is refuted by the circumstance that sexual attributes of the grandmother can be transferred through the father to the granddaughter, and, inversely, sexual peculiarities of the grandfather through the mother to the grandson. The influences which lead to the development of one or the other sex may possibly act upon the sexual products during their elaboration of the ancestral organism. The tendency to produce a given sex may be developed in the two conjugated cell-nuclei either in the same or in opposite directions, in which latter case the stronger predominates. A perfect equilibrium of the tendencies of cell-nuclei having opposite directions is also possible, the result being the formation of a hermaphrodite.

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English Worthies. Edited by ANDREW LANG.
Charles Darwin. By GRANT ALLEN. London: Longmans, Green, and Co.

YEARS must pass before Charles Darwin's exact position in the history of science can be definitely and finally established. At present disputes concerning his merit and even his personal character are still raging. If he is no longer assailed by the organs of religious opinion, as in the years immediately succeeding the appearance of the "Origin of Species" and the "Descent of Man," it must not be supposed that he everywhere meets with due honour and appreciation. The anti-Darwinian warfare has been taken up by authors who, whatever else may be their motive, certainly do not speak in the name and in the interests of Christianity, for which some of them do not care a straw. In view, therefore, of the writings of Mr. Samuel Butler and Mr. Oswald Dawson, it is well that a full and fair exposition of the views, the methods, and the merits of our great English biologist should be laid before the public.

Such an exposition will be found in the work before us. Its author, Mr. Grant Allen, is not merely an evolutionist in the wider sense of the term. He is a Darwinian of the Darwinians —an orthodox believer in natural selection. That whatever he knows and believes he can clothe in pellucid language, not merely intelligible but fascinating to the great "educated and respectable" classes, will be readily admitted by all persons who are familiar with his numerous contributions to periodical literature. Accordingly we meet in this volume little, perhaps, which is novel, profound, or suggestive, but abundance of thoughts expressed with a singular felicity. In the very outset he reminds the reader of what many fail to see, that a great man has, so to speak, a two-fold line of ancestry—his bodily parents, grandparents, and more remote ancestors from whom he derives his personal qualifications, and, on the other hand, his forerunners, or, as Mr. Allen calls them, "his intellectual and moral ancestors, the thinkers and workers who have preceded him in his own department of thought." All this, and its corollaries, are known, of course, to every reflective mind, but few could have expressed this important truth so happily as it may be found in the book before us.

Starting from this basis, Mr. Allen combats the popular mis-

apprehension which regards Darwin as the discoverer and founder of the hypothesis of evolution, the first to suppose animal and vegetable forms to be the outcome, not of special, mechanical creation, but of slow modification in pre-existing organisms, and especially the first to suggest the possible descent of man from an ape-like ancestor. This position had, however, been previously taken by others, for instance, Buffon, and Darwin never for a moment represents himself as having been its originator. His task was to show how descent with modifications might be effected—to make the theory of development comprehensible and believable.

Our author, in order to refute this misconception, gives a sketch of the evolutionary doctrine as it was held by some of the most eminent naturalists prior to the avatar of Darwin.

In this survey we find Lamarck characterised as "a bold, acute, and vigorous thinker, trained in the great school of Diderot and D'Alembert, with something of the vivid Celtic poetic imagination, and a fearless habit of forming his own conclusions irrespective of common or preconceived ideas." But has it never struck Mr. Allen what a large proportion of the opponents of Evolution in general, and of Darwinism in particular, are manifestly Celts? How Celtic France, the western portion of Switzerland, Ireland, and Scotland, have remained strange or hostile to the new biological school?

Cuvier is characterised as "a reactionary biological conservative and obscurantist." We submit that the term "conservative" is not happily chosen. "Oken," it is said, "was spinning in metaphysical Germany his fanciful parodies of the Lamarckian hypothesis." Those who are familiar with Oken's works in the original, and especially the few survivors of his pupils, will think that he here receives but scant justice. It is startling to reflect how many of the most advanced conceptions of modern science lurk in germ in the strange and, at times, uncouth phraseology of his writings. But to return, in the account of Darwin's early days we find some remarks which we can most heartily endorse. Thus: "The boy was educated (so they call it) at Shrewsbury Grammar School, and there he picked up as much Latin and Greek as was then considered absolutely essential to the due production of an English gentleman. Happily for the world, having no taste for the classics, he escaped the ordeal with little injury to his individuality." After a short stay at Edinburgh University, he proceeded to Christ's College, Cambridge. "The Darwins were luckily a Cambridge family: luckily, let us say, for had it been otherwise—had young Darwin been distorted from his native bent by Plato and Aristotle, and plunged deep into the mysteries of Barbara and Celarent, as would infallibly have happened to him at the sister university, who can tell how long we might have had to wait in vain for the "Origin of Species" and the "Descent of Man?" But

Cambridge, which rejoiced already in the glory of Newton, was now to match it by the glory of Darwin. In its academical course the mathematical wedge had always kept a dim path open for physical science."

In the same spirit Mr. Allen further writes: "Fortunately for us, then, Darwin did not waste his time at Cambridge over the vain and frivolous pursuits of the classical tripos. He preferred to work at his own subjects in his own way, and to leave the short-lived honours of the 'schools' to those who cared for them and for nothing higher. . . . . He chose that better part which shall not be taken away from him as long as the very memory of science survives." We cannot help exclaiming, honour to the man who, in this land of still rampant 'humanists,' dares to speak so plainly of word-mongering! In this work we find no mention of the fact that Robert Darwin destined his illustrious son for the Church, and with difficulty consented to his joining the ever-memorable "Beagle" expedition. What a danger escaped!

Passing over the narrative of this voyage, the lessons of which are brought into full light, we come to the "period of incubation," when the observations which young Darwin had made in his wanderings were being co-ordinated into the great body of evolutionary doctrine. Here a saying of Professor Fiske's is very appositely quoted: "There is one thing which a man of original scientific genius in a rightly-ordered world should never be called upon to do. He should never be called upon to earn a living, for that is a wretched waste of energy in which the highest intellectual power is sure to suffer serious detriment, and runs the risk of being frittered away into hopeless ruin." This is a wholesome lesson for the believers in competition!

Of the rank and file of scientific workers Mr. Allen speaks, as it seems to us, with too little respect. The great discoverer, in closing every "loop-hole of an objection," does but repeat publicly the process by which he has first convinced himself. "Non-biological minds" may, perhaps, give in their adhesion more readily because they are not familiar with the thousand and one phenomena which a new theory must explain.

Of the "Vestiges of Creation" we find an uncomplimentary notice. It is described as "Lamarck and water, the watery element being due in part to the unnecessary obtrusion (*more scotico*) of a metaphysical and theological principle into the physical universe."

It is, perhaps, surprising that attention is not called to one of the favourable circumstances which attended the first promulgation of the new theory. England was at rest; the Crimean War and the Indian Mutiny were over, and, most of all, there was no political agitation on foot. Had the "Origin of Species" been first published at any date from 1876 to the present day it would have excited little interest save among specialists.

The arguments both of the friends and the opponents of evolution would have been drowned among the din of organised factions, the orations of itinerant Jack Cades, and the cheers of a multitude rushing violently down a steep place into ——?

We find here Alfred Russel Wallace spoken of as "a young Welsh biologist." This is surely a mistake. The name Wallace, as well as the *prænomina*, are assuredly not Welsh, and, to the best of our recollection, Mr. Wallace was not born in the Principality.

Concerning the respective merit due to Darwin, Wallace, Wells, Matthew, and Spencer, Mr. Allen writes: "It was Darwin's task to recognise the universal where Wells and Spencer had seen only the particular; to build up a vast and irresistible inductive system, where Matthew and Wallace had but thrown out a pregnant hint of wonderful interest and suggestiveness.

We come now to what appears to us a grave error. Mr. Allen writes: "For the world is perpetually overpopulated. It is not, as many good people imagine, shortly going to be overpopulated; it is now, it has always been, and it always will be, pressed close up to the utmost limits of population." If the world had always been overpopulated, how did it happen that children were regarded not as a burden but as a blessing? How came it that, in the days of Queen Elizabeth, as Hallam shows in his "Constitutional History of England," the wages of a working-man represented a larger proportion of the necessaries of life than they do in our progressive days? What, lastly, has become of "the full-blooded tendency of the eighteenth century" which Mr. Allen himself mentions? Even in the lower animals, where Mr. Allen is nearer the truth than with respect to man, we find that certain wild species must have fearfully increased.

Again the author considers that most people "misunderstand the meaning of the phrase 'struggle for existence.' They imagine that the struggle is chiefly conducted between different species, whereas it is chiefly conducted between members of the same species." But what exterminated the native flora and fauna of St. Helena? The goat. What is laying waste South Africa, so that a troop of the Cape Mounted Rifles actually cheered on meeting with a tree when on the march? The goat. What are fast eradicating the interesting native floras of West Australia and California? European weeds. These and other instances on the large scale show that there is a most desperate struggle between different species, and that this struggle, when it becomes sufficiently intensified, instead of forming new varieties or species, leads to their extermination.

Mr. Allen's work deserves careful perusal by all who would wish to form a truer estimate of Darwin than that which they might gather from the works of Mr. S. Butler.

Our Insect Enemies. By THEODORE WOOD. London: Society for Promoting Christian Knowledge.

WE have here a little book full of most useful information concerning that very numerous class of beings, insect pests. It will, we hope, help to teach John Bull the lesson which Brother Jonathan has already learned, *viz.*, that insects and their study are not to be despised, since among their ranks we find the most formidable of our animal enemies, with which we cannot hope to grapple successfully so long as we choose to remain in ignorance of their life history. Without endorsing all the author's speculative views upon the possible utilities of certain insects, we think he has done good service by pointing out the many important problems in their economy which still await solution. To take some of these in hand will surely be a more honourable and useful way of studying entomology than that we too often see, *i.e.*, capturing or buying an assortment of "British" Lepidoptera and pinning them, in fantastic patterns, in a glass case.

We notice in the introduction a statement referring to an obsolescent order of things: the Cochineal insect, as a source of scarlet and crimson dyes, is fast becoming a thing of the past.

Mr. Wood's remarks on the inestimable services rendered us by carnivorous insects and insectivorous birds are well timed. We often slaughter our allies out of ignorance or prejudice. But we are unable to accept his pleadings in favour of the sparrow. Not only is it, during the greater part of its life, a destroyer of grain, fruits, and blossoms, but, by its too often successful persecution of the martin and the swallow, our great safeguard against the multiplication of gnats, it inflicts on us a serious injury. Where the extirpation of sparrows in any locality has been followed by the increase of caterpillars, &c., we believe it will be found that the mischief has a very different cause. The truly insectivorous birds have been scared away by the clumsy methods taken for the slaughter of the sparrows. This much is certain, that wherever the sparrow has been introduced, in America, Australia, and New Zealand, it has been pronounced an unmitigated nuisance by a majority both of naturalists and of farmers and gardeners. Sparrows have been shot and the contents of their crops carefully examined under the microscope, with the result that insects do not form one-tenth of the diet of these depredators.

Amongst the enemies of the Aphides one, or rather a group, is here overlooked. The beetles of the genus Telephorus, popularly known as "soldiers and sailors," and several of their near allies, are indefatigable devourers of the Aphis. Spiders, also, especially of the genus Epeira, ensnare a legion of plant-lice when in their winged state.

An unfortunate fact is that Aphides have their protectors as well as their enemies. Ants not only defend these vermin against attacks, but have even been known to re-introduce them upon trees which have been cleared at great labour and expense. Hence, as a preliminary to attacking the aphides, it is necessary to wage war against the ants with carbolic acid and corrosive sublimate. We do not find here any reference to ants—such as the leaf-cutters—and to the termites as enemies of man.

The horrible taste and smell of the field bugs, both in this country and abroad, are duly noticed. The author describes very graphically his experience on accidentally swallowing a bug along with the berry upon which it was sitting. He does not exaggerate, for we once put into our mouth a fine blackberry on which a specimen of a beautiful Hungarian species was sitting. We did not swallow the dainty morsel; still we did not get rid of the savour for the remainder of the day. One important point overlooked is the suspicion, now almost amounting to a certainty, that fleas, bed-bugs, mosquitoes, &c., may transfer diseases from one person to another, and may inoculate man with the poison of swamp fever.

The wasp has been here omitted. Yet in districts where they are abundant it is almost impossible to protect choice fruit from its ravages.

"Our Insect Enemies" should be generally read in country districts, and its teachings should be carried into practice.

Proceedings of the Bristol Naturalists' Society. New Series, Vol. IV. Part III (1884-5). Bristol: James Fawn and Son.

This volume contains papers on the Mapping of the Millstone Grit at Long Ashton, by Prof. C. Lloyd Morgan, F.G.S., in which the author corrects an error committed by Mr. Sanders in the boundary of the Millstone Grit. Dr. S. F. Burden contributes a paper on the total eclipse of the moon, October 4th, 1884, rendered noteworthy by the unusual fact of the almost total extinction of the moon to the naked eye. He suggests the solar corona as the source of the light which generally illuminates the eclipsed moon. Prof. C. Lloyd Morgan, in a second paper, considers "Sub-aërial denudation and the Avon Gorge." In his conclusion he remarks that "the general denudation which has removed all the inferior oolite, not to mention the newer rocks which almost certainly overlaid it, and nearly all the Lias from our district, demands almost more of our wonder and our faith in geological principles than the special denudation which has cut for us the Avon Gorge."

Mr. Bucknall continues his catalogue of the Fungi of the Bristol district.

Mr. E. Wilson, F.G.S., curator of the Bristol Museum, furnishes notes on a common Fin Whale (*Physalus antiquorum*) recently stranded in the Bristol Channel. Mr. C. T. Druery, F.L.S., gives an account of thenewly-discovered phenomenon of "apospory" in Ferns, *i.e.*, the production of the prothallus upon the parent plant without the mediation of the spore.

From the table of the rainfall at Clifton it appears that the total rainfall there fell short of the average of the last 30 years by less than 1 inch.

Records of the Geological Survey of India. Vol. XVIII., Part 3. 1885.

In this issue we find a paper by Mr. R. D. Oldham on the Geology of the Andaman Islands. The author finds reason to examine the common theory that the Andamans have been and are subsiding. He meets the evidence of subsidence at the present day, which, however, has apparently set in only recently.

Mr. Medlicott furnishes an account of the Pirthalia and Chandpur meteorites. The fall of the latter seems to have been attended by a thunderstorm.

Dr. Romanis reports on the oil-wells and coal in the Thayetmyo district in British Burma. The yield of oil is only about one barrel per month. The coal deposits of the Amakan Yoma seem to have been formed in the swamps and lagoons of a river-delta. Those at Thayetmyo have originated during a period of subsidence. It is thought that there are two seams of four feet in thickness, separated by 60 to 70 feet of shale.

Mr. W. R. Criper communicates a note on the antimony deposits near Maulmein. The ore is found not in lodes, but in disconnected deposits, and seems incapable of profitable working. The rainfall at Maulmein is from 170 to 220 inches yearly.

Proceedings of the Literary and Philosophical Society of Liverpool, during the 73rd Session, 1883-84, No. XXXVIII. London: Longmans, Green, and Co. Liverpool: D. Marples and Co.

This volume contains some valuable papers, though, as is too often the case, matter not of general interest appears, to us at least, to occupy too large a share of space.

The President, Mr. R. Steel, read an important memoir on "Mind in Man and in the Lower Animals," and came to the only legitimate conclusion to be drawn from the facts, *viz.*, that "the processes which go to constitute man's mental activities are found as truly in their measure in the brute," and again "Man's claim to be something entirely different in his powers from the lower animals must be peremptorily dismissed."

Speaking of the senses, he remarks that the higher forms of the brute creation possess as many as man himself." Do not some insects possibly—nay, probably—possess more? What, for instance, is the meaning of the two, and even three, kinds of eyes in certain insects?

"Parrots," Mr. Steele writes, "can repeat many sentences, and obviously connect them with certain subjects. I do not, of course, say that the parrot understands what it says in the same manner that the human being understands the same words? Here one word is wanting; it should have been said "the *adult* human being." A parrot's use of language is very closely similar to that of a child of one and a half or two years of age. The bird distinguishes and applies rightly not only nouns but verbs. We know a parrot which almost invariably says "What you want?" if any person seems to open drawers, turn over papers, &c. "What you got?" if anyone enters the room with a basket or a bag; and "What you doing?" if any unusual action is performed in her presence.

In a discussion on induction he brings forward a caution too commonly overlooked. He writes: It is possible to show from still another point of view the fallacy of postulating these laws (*i.e.*, those of number, space, and causation). The laws of number and space are purely hypothetical. The whole theory of number rests upon an assumption—that of unity. But the idea of unity is a subjective abstraction. There is no such thing in nature or in the compass of our experience as absolute unity, and therefore all arithmetic, which is developed from the idea of absolute unity, is, to our apprehension, exactly true only because in its every step it carries with it the original assumption. But that cannot be an absolutely certain induction which contains in its every step a pure assumption, so that the science of number has no such claim to infallibility as Mill assigns to it."

The Rev. T. P. Kirkman, F.R.S., the author, as our readers will remember, of a "Philosophy without Assumptions," communicates a "Description of the 24-Edra, having only Triad Summits, and for Faces only Pentagons, Hexagons, Heptagons, and Octagons, which are reducible to the regular Dodecahedron." He admits that his results are, "like most mathematical results, of no further use than to prove the power of the method."

Dr. W. A. Herdman is the author of a paper on the "Theory

of Heredity," interesting to men of science and hated to persons of the demagogue type, as cutting away some of their pet theories.

Dr. Hayward replies in a paper on the "Modification of Hereditary Transmission by Mental and Educational Influences." We note, in passing, the "*and*." He seeks to uphold the old error that educational and social training, and mental and moral influences (Are not "mental" influences moral influences, and conversely?) are the "most potent of the means for improving the human race." He considers Eugenism—the improvement of the race by judicious marriages—impracticable. Certainly, if the community and the whole species are to be sacrificed to the individual and his whims, this must be the case.

The admirable paper by the Rev. H. Higgins, M.A., on "Museums of Natural History," has already come under our notice in its separate form.

W. G. Black, F.R.Met.S., supplies a paper on "Anemometers for Ships," destined to allow the officer in charge to judge by mechanical means of the force of the wind on the sails at any time required.

Mr. R. J. Gibson, M.A, read a paper on the "Flora and Fauna of Oceanic Isles." His remarks are at present confined to the Açores; on some future occasion he will treat of the Galapagos and St. Helena. A curious contradiction is mentioned as regards the goldfish found on the little volcanic lakes of these islands. On the one hand, we are told that they are so numerous that one cannot put one's head into the water without touching them, "and, on the other hand, that they die by thousands, and their dead bodies are thrown up on the shore all in a condition which show that they have died of starvation, there being no food for them in these lakes." How, then, do they continue so numerous? The author considers that the original life of these islands had a strong resemblance to that of America, but that the present fauna and flora have been mainly introduced from Europe by human instrumentality.

Finally, Dr. J. B. Novins gives an interesting "History of the Introduction of Peruvian Bark Trees (*Chinchonas*), and the Present State of Cultivation in India."

We are still of opinion that all the "Literary and Philosophical" Societies of Britain would be rendered much more healthy and efficient by a process of "dissociation."

Manual of Telegraphy. By W. WILLIAMS. London: Longmans, Green, and Co.

THIS work, as the Preface informs us, has been compiled by order of the Director-General of the Indian Telegraph Department. Its objects are to afford the Staff a means of self-education in practical telegraphy; to serve as a primer and companion to the Department's testing instructions; for the instruction of probationers, and as a text-book of ready reference. Like the vast majority of English manuals in any department of Science, it is based on the substance of "papers set" at general examinations. In its successive sections it considers the definition of technical terms, batteries, instruments, telegraphic circuits, detection and removal of faults, the testing of batteries, of lines, earths, lightning conductors, instruments and connections, besides an Appendix treating of the laws and principles by which the conduct of electrical currents may be understood, and on which the solutions of formulæ are based; also electrical formulæ and their solutions, and a table of natural sines and tangents.

The work is clearly written, well illustrated, and perspicuously arranged.

Journal and Proceedings of the Royal Society of New South Wales for 1884. Vol. XVIII. Edited by A. LIVERSIDGE, F.R.S. Sydney: Thomas Richards. London: Trübner and Co.

FROM the Anniversary Address delivered by the President we learn that of the prizes offered by the Society, for the best Memoirs on certain specified subjects, only two have as yet been awarded. Of the nine Memoirs sent in last year none were found satisfactory. It is to be regretted that, in a country where so much remains to be discovered, there should not be a greater zeal for research.

It appears also that the Society made such a donation to the funds of the Zoological Station established on the coast (a true Aquarium, like the one at Naples) as to entitle it to nominate a worker in the Laboratory, but no one applied for this privilege! If we consider that on the east coast of Australia there must be far greater scope for investigations in Marine Zoology than at Naples, this apathy is much to be regretted. If three publications are needed to chronicle the work done at Naples, six ought at least to be filled with the records of New South Wales researches.

The speaker, in describing his late visit to Europe, mentions that the supply of Iceland spar fit for making Nicol prisms is at an end, the mine being exhausted. Mineralogists would do well to search for new sources of this important crystal. He has made frequent use of a "rain-band spectroscope" for more than a year, but only on one occasion has it given a distinct indication of rain earlier than the usual atmospheric signs.

Reviewing the evening after-glows which have been so much discussed for some time, Prof. Smith concludes that if dust is the source of the phenomenon its origin is cosmic.

Among the Memoirs here inserted we notice in particular:—

The Trochoided Plane, by Lawrence Hargrave. The author contends that the trochoided plane is the mechanical power almost universally used by Nature for the transmission of force in living creatures. As an example he takes the back fin of a fish. "Observation will show that the ends of the spines that keep the membrane extended are points in the curve of sines or trochoidal wave, and that if they are rotated on their axes in unison, or oscillated from side to side harmonically, a series of complementary waves will be thrown by the membrane towards the tail. This action of the fins is best seen when fishes are confined in a bowl, and appears to be only used when the speed does not necessitate the use of the large muscles of the body. . . . If we conceive the action of the back fin as thus described to be communicated to a series of legs on each side, as in the centipede, the effect will obviously be progression along a surface; and if we cut off all the legs but two pairs, separated by a distance equal to one wave-length, we have the quadrupedal action popularly assigned to the giraffe; if the two pairs are only half a wave-length apart, we have the trotting pace of a horse; and the various other paces become clearly dependent on the length of the wave used by the animal. The legs and body of an alligator or lizard show the connection between many-legged and four-legged progression. . . . But it is impossible to define any hard-and-fast line between any two classes, as the more instances of progression we notice the more it is forced upon us that they are but links in a chain the two end links of which are unknown, whilst any two adjoining links are hardly distinguishable. The swinging of the hands and arms, in walking and running, is evidence that bipedal is evolved from quadrupedal progression, which to me seems to have developed from the trochoidal action of a fin. When the amplitude of the waves is in a vertical plane, each pair of legs is moved together, and the form of the wave is plainly seen in the back of a dog when going full split (*sic*). This method of progression reaches its extreme form in the hopping birds."

It seems that it might be interesting to re-examine the locomotion of animals from the author's point of view. We regret, however, to find that the author is seeking to apply his theory to

the problem of artificial flight, the solution of which, prior to a total change in the moral condition of mankind, would, it seems to us, be the direst calamity conceivable.

Mr. H. C. Russell, the Astronomer Royal for New South Wales, read a Memoir on a new form of Actinometer, to show not only the hours when the Sun shines, but also the intensity of the heat.

Mr. C. Moore, F.L.S., read Notes on the Genus *Doryanthes*, the "Great Lily" of Australia, giving description of a new species. This plant, which grows to the height of 20 feet, is not a true lily, but an *Amaryllis*. It is not only remakable for the beauty of its red flowers, but yields a fibre remarkable for its tenacity and silky lustre. It can be obtained in threads 3 feet long, and can be produced to any extent.

Mr. W. H. Caldwell, M.A., communicated a most important paper on the Development of the *Monotremes* and of the *Ceradotus*. It is interesting to remember that this investigation was suggested to him by the late lamented Professor Balfour. He describes first the reproduction of the marsupials, now the characteristic animals of Australia. The main difference between them and ordinary mammals is that in the latter the embryo before birth has no vascular attachment to the walls of the uterus.

The *Ceratodus* is a representative of a series of animals once very numerous, but having now three living representatives only—the *Ceratodus* of Queensland, the *Lepidosiren* in the Amazon, and the *Propterus* found in certain African streams. These three animals possess gills, and have in their adult state the form of a fish, but they have also lungs. There is an indication of two chambers in the heart, and of the presence of arterial blood. The egg of the *Ceratodus* undergoes a complete segmentation, like that of the kangaroo.

The author's most important discovery is that the *Monotremes* are reproduced by eggs, the *Ornithorynchus* laying two, and the *Echidna* only one. These eggs, like those of birds, and unlike the true mammalian ova, contain a large food yolk. Nevertheless both suckle their young.

It is laughable to find that during the last few weeks before his Memoir was read Mr. Caldwell had received several letters denying that the *Platypus* laid eggs, and wanting to argue about it. Now, as he remarks, a fact may be disbelieved, but it cannot be argued about.

The Kansas City Review. New Series. Vol. IX., No. 1. August, 1885.

THIS issue contains a very large proportion of interesting and useful matter.

The first article discusses the "Relations of Archæology to History," and makes the startling, though perfectly justifiable, assertion, that "The tremendous physical forces which a single man now summons to his aid may threaten us with a speedy return to barbarism, for certainly the morals of a railroad corporation are no improvement on those of Confucius." Meditating somewhat discursively on this paragraph, we might ask whether ancient civilisations, of which no account has reached us, may not have been overthrown in the manner here hinted? We have seen it somewhere stated that the man whose culture is greatly superior to his wealth is a nuisance to himself, and, on the contrary, he whose wealth exceeds his culture is a nuisance to others. Might it not be said that the nation whose physical and intellectual development exceeds its moral progress is a peril to its neighbours, whilst the one whose moral culture outstrips its physical and intellectual culture is a peril to itself?

May we not also—with a writer in a very heterodox, but thoughtful, contemporary—ask whether the rule of combined capitalists may not prove more grinding than that of any conqueror, feudal baron, or priest of antiquity and the Middle Ages?

We find it further truly said:—"There is no law of limitation with man, except his capacity to take. . . . There is every reason to suppose that the highest development of man is capable of exhausting all the means which the Earth can offer for his support."

A Memoir on the "Industrial Achievements of the Ancients," though revealing no fact absolutely novel to the learned, may act as a wholesome cooling-draught to us moderns, suffering from the fever of self-worship. It is already certain that in our popular speeches and writings we vastly underrate both the abstract knowledge and the industrial skill of the remotest antiquity. But what a light would dawn upon us could we reproduce the books burnt, not by the Caliph Omar, but by the monks of Alexandria?

In a Paper on "Moral Microbes" we find the term used in a novel sense,—applied, that is, to evil impressions implanted in the individual. We have incidentally applied the kindred term "Schizomycetes" to individuals who disorganise the communities among which they live by setting on foot "movements," such as Bestiarianism.

In the "Round of Life" we meet with the remark that "The grand and most obvious distinction [between plants and animals]

lies in the fact that all vegetables, except some families of parasitic plants, and perhaps some species described as carnivorous plants, feed alone on inorganic matter, while animals derive their sustenance from organised matter." But surely a distinction which admits such exceptions as are here fully acknowledged can neither be grand nor obvious. If bacteria, &c., were not nourished upon organic matter, how could they either decompose the remains of plants and animals or induce diseases?

"Zoological Enigmas" is a collection of curious but little-known facts in Natural History. The existence of a land serpent of 55 feet in length, like the *ular sawad* which Sir Stamford Raffles saw on the coast of Sumatra, is often forgotten. As for the huge serpents said to have occurred in Europe within historical times we feel very sceptical. "Pliny states that a serpent killed in the Pontine Marshes, during the reign of the Emperor Claudius, had the entire body of a child in its stomach; and Suetonius mentions a python 50 cubits (75 feet) in length, that was killed near Agrigentum in Sicily, and exhibited in front of the Comition." Pliny, however, is an exceedingly poor authority, as in compiling his great work he seems to have gathered up every old wives' fable that came to his ears, without any attempt at verification.

The story of the serpent which, in Numidia, kept a whole Roman army at bay on a ford of the Bagrada, and after killing fourteen soldiers who had attacked it with their swords was at last crushed by a stone hurled from a balista, is more credible as far as the locality is concerned. Even down to the present day huge serpents are said to haunt some of the ravines of the Atlas.

We have next reference to the Brazilian tradition of a monstrous underground serpent which tunnels its way under the roots of the forest, or occasionally overturns large trees. But some versions of the story seem to point rather to a monstrous earthworm. This myth is, we believe, being specially investigated by Dr. Fritz Müller, F.E.S.

The classical myth of the harpy is traced, with great probability, to the "flying fox" of Java and other parts of the Malay Archipelago.

Lastly, the author of this paper discusses the belief in vampires. This belief, in various forms, is widely current in Roumania, Hungary, the South of Russia, and even in Upper Silesia. A recent Hungarian writer contends that this notion has a zoological basis, *viz.*, "the existence of nocturnal *Mindes* allied to the land-leeches of Ceylon, and gifted with the caution of the South-American vampire-bat, which Waterton so well describes. In support of this belief a strange story is given of certain mysterious deaths which had happened in a turret-chamber in the mansion of the Counts Lermonhoff, near Odessa. In 1824 a son of the family, eager to solve the mystery, slept in

the turret-chamber, which had been in the meantime cleaned and most carefully examined. The rest of the story we give in the words which we here find:—"He [the steward] was waked by a scream that made his blood freeze. What had happened he was unable to say: all he remembered was, that in his last agony the unfortunate man [the Count's son] had thrown his head to and fro and pressed both his hands over his temple, where they remained even now, firmly interlocked and rigid in death. When they at last succeeded in unclasping his hands they found under his fingers, with its sting imbedded in the seams of its victim's skull, an unknown animal, which can now be seen in a vial of spirits of camphor in the Museum of Odessa. In shape the nondescript appears like a cross between a leech and a lizard, but its tail, like that of a scorpion, terminates in a sharp point. Where it came from—if it had lurked in the fissures of the ceiling, or entered by some secret aperture—has never been explained." Further light is here evidently wanting. If such a creature exists, might it not be the cause of the two mysterious deaths said to have occurred in a mansion in one of the West-end squares?

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE BELGRAD DISTURBANCES.

MAY I ask wherein these occurrences differ from those reported as having frequently happened during the Dark Ages, but which were unknown in the earlier half of this century? If fiends, or, as they are now euphemistically* called, Polter Geister, can produce such phenomena without the intervention of a medium, we are plainly mere playthings for evil spirits. For, if the streets of Belgrad are rendered at times impassable by showers of stones, flung by no visible hand, what guarantee have we that the streets of London or Paris may not be bombarded in like manner? If such things cannot happen without the co-operation of a medium, it seems to me that he or she stands exactly in the shoes of the mediæval witches, and is *particeps criminis*. If the fiend is powerless without the medium's aid, but with that aid can work mischief, the medium may surely be regarded and treated as a public enemy.

R. M. N.

* Our correspondent's term is "beschoenigend," which we are obliged to translate into English as above.—ED. J. S.

NOTES.

We learn that the Institute of Chemistry has obtained a Royal Charter. Consequently the constituents are now entitled to append the letters F.I.C. to their names, which many of them have hitherto been doing illegitimately.

In some parts of Essex a snail is called a "hod-my-dod," even by persons of education, and the wild rose is known as a "Canker."

The "Journal of the New York Microscopical Society" gives a curious list of reputed prodigies, showers of blood, milk, oil, flesh, &c., and bloody springs.

On September 26th the thermometer fell at Paris to 2° C., and in the night even to 0·7°. At the same time the temperature at Moscow was 8°, at St. Petersburg 5°, at Stockholm 6°, and at Copenhagen 7°.

With reference to the destruction of young trout by mosquitoes, it appears that these pests in cold climates are much stronger and better armed than in hot countries; in Newfoundland and the North of Asia they can perforate a leather glove.

According to M. Richet the physiological action of rubidium is similar to that of potassium, but it is less poisonous by one half.

A notion—whether well- or ill-founded we know not—prevails in Turkey that leprosy may be occasioned by a stroke of lightning.

According to Mr. B. Blount certain specimens of copper pyrites, from the County Cork, are so explosive that they have to be rejected by manufacturers of sulphuric acid.

Floating ice has recently been found near the Norwegian coast, in the latitude of Bergen,—a phenomenon of which there is no previous record.

Recent palæontological researches go to show the impossibility of drawing any definite line of demarcation between the Carnivora and the Insectivora.

On August 10th snow fell in the province of Rio Grande do Sul, in Brazil, to the depth of 6 inches. The district is near the coast, and not mountainous.

At the recent meeting of the American Association for the Advancement of Science the Section of Microscopy and Histology was abolished. This is a step in the right direction. Histology is simply a branch of Biology, and Microscopy is a case of "cross-divisions."

Said a lecturer before the Society of Arts:—"When large London estates were rapidly covered with houses, that scourge of London arose—the modern speculative builder. Calculating on a rapid fortune, he invented one house. That one house has been repeated *ad infinitum*,—a forlorn design it is, and the example so profitable to the builder has covered modern London with the dreariest streets to be seen anywhere in Europe."

Mr. A. B. Lee contends that the halteres of the Diptera contain, besides the organs of hearing, other organs of doubtful function.

Dr. Shufeldt, writing in "Science," confirms the experiments of Miss von Chauvin on the tranformations of the axolotl. He finds that the metamorphosis is hastened by abundance of suitable food and by a moderate increase of temperature, and retarded by an extra depth of water.

Whilst cheerfully acknowledging the many services which the late Earl of Shaftesbury rendered to the country, we are bound to put on record our profound regret that he should have lent his name and influence to that deplorable outburst of fanaticism, the Bestiarian movement.

Dr. Rohé maintains that the rate of self-purification in rivers is limited, and may be easily exceeded by the rate of pollution.

[We are not aware that anyone has questioned these propositions.]

Prof. H. Drummond claims for the termite (*vulgo*, white ant) a very important part in the formation of soils in tropical countries.

In the present smallpox epidemic at Montreal the deaths up to a certain date were—Catholics 750, Protestants 35. The Catholics reject vaccination, and the Protestants accept it. The "Echo," a well-known anti-vaccinationist organ, admits that, if vaccination is useless, at least 250 Protestants should have died to equalise the death-rate.

Mr. R. A. Mullan, an Irish solicitor, observed during a recent hailstorm in County Down that some of the stones were decidedly red, and this not merely on the surface. On melting they stained his fingers.

It is asserted in some quarters that H. Milne-Edwards, towards the close of his life, gave in his adhesion to Evolutionism.

Others, however, assert that he died impenitent, a hardened Cuvierian to the last.

We regret to learn that the "Kansas City Review" is in danger of coming to a close for lack of public support. The editor, Mr. T. S. Case, has conducted this journal for seven years at a considerable loss to himself. It will be discreditable to the inhabitants of Kansas if the career of so useful an organ should be cut short.

"The Museum," formerly of Philadelphia, has now been incorporated with the "American Antiquarian."

The superstition still prevails, even in London, that the death or disappearance of a black cat forebodes evil to its owners.

Prof. Brauer divides insects into six super-orders and sixteen orders. He holds that there are no connecting types between the orders now existing, and that the path to a common ancestral form is interrupted in many places.

Among the multitudes who will deplore the premature death of the illustrious chemist Walter Weldon, not many, probably, will be aware that the deceased was an avowed Spiritualist.

The occurrence of native iron, not of meteoric origin, in Greenland, is now placed beyond doubt. It may even become of commercial importance.

It is hoped in some quarters that the death of Dr. Robin, following so soon upon that of H. Milne-Edwards, might effect a reform in the Section of Anatomy and Zoology of the French Academy of Sciences, by eliminating a part of the Comtean and anti-evolutionist element from that retrogressive body. We fear, however, that the influence of the surviving members will dictate the manner in which these vacancies will be supplied.

Literary Announcements.—An important and comprehensive new work for merchants, manufacturers, and others, by William Chadwick, accountant, entitled "The Combined Number and Weight Calculator," will shortly be issued by Messrs. Crosby Lockwood and Co., London. The work will show at a glance on any page (1) any number of articles consecutively from 1 to 470; (2) any number of cwts., qrs., and lbs., from 1 cwt. to 470 cwts.; (3) any number of tons, cwts., qrs., and lbs., from 1 to 23¼ tons at 421 different rates ranging from 1-64th of a penny each to 20*s.* each, or per cwt., and £20 per ton; the whole comprising over 250,000 direct calculations, which, with one addition, will produce upwards of twenty-five millions of calculations.—The same publishers also announce for immediate publication, "Electro-Deposition, a Practical Treatise on the Electrolysis of Gold, Silver, Copper, Nickel, Cobalt, Iron, and all other Metals

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